Gait and Cognitive Abnormalities: Normal Pressure Hydrocephalus and Pilates
Abstract

Dr. Charles Stone began Pilates after completing rehabilitation for a knee replacement. Shortly thereafter, he noticed there was a decline in his motor skills specifically regarding gait and was diagnosed with Spinal Stenosis of the cervical spine. After a surgical procedure, his Pilates program was modified to focus on improving gait and balance. When the condition worsened and included cognitive changes, Dr. Stone was misdiagnosed with Parkinson’s. I adjusted his exercise program to rudimentary movements including modified Pilates exercises. After an accurate diagnosis of Normal Pressure Hydrocephalus, another surgery was recommended. With this surgery and Pilates, there was a dramatic improvement in motor and cognitive skills. Currently, my focus is to bring Dr. Stone to an Intermediate level using the BASI Block System with modifications specific to his condition.
# Table of Contents

Abstract .............................................................................................................................................. 2

Normal Pressure Hydrocephalus .................................................................................................... 4

NPH Treatment with Diagram ........................................................................................................ 5

Introduction ......................................................................................................................................... 6

Body .................................................................................................................................................. 7

Conclusion .......................................................................................................................................... 13

Bibliography ....................................................................................................................................... 15
Normal Pressure Hydrocephalus (NPH)

When functioning well, cerebrospinal fluid surrounds the brain and spinal cord in order to protect them; it supplies necessary nutrients and removes waste of the brain and spinal cord. When the fluid does not circulate and drain properly, it builds up in the brain's ventricles, causing a condition known as hydrocephalus. As a result of the excessive accumulation of fluid, the ventricles swell in size, putting pressure on surrounding parts of the brain, causing a variety of complications having multiple symptoms. (Espay, 2013)

Symptoms of NPH

Adult-onset NPH mainly occurs in adults 60 years and older; my client, Dr. Stone, was 73. There are three main symptoms, changes in gait, dementia, and impairment in bladder control. Neurologists refer to this in layman’s terms as wobbly, wacky, and wet. Dr. Stone exhibited all three of these symptoms.

Change in Gait

This is often the most pronounced symptom and the first to become apparent possibly preceding the other symptoms by months or years. The characteristic gait is often demonstrated by a wide based, short-stepped, slow and shuffling type of walk which Dr. Stone demonstrated. Magnetic gait is used to describe the tendency of the feet to remain stuck to the floor despite the person’s best efforts to move them.

Dementia

It can be described as a loss of interest in daily activities, forgetfulness, difficulty dealing with routine tasks and short-term memory loss which Dr. Stone also began to demonstrate. It presents as an impairment of recent memory or as a slowing of thinking.
**Impairment in Bladder Control**

Usually characterized by urinary frequency and urgency in mild cases, a complete loss of bladder control (urinary incontinence) can occur in more severe cases. (HiFI Hydrocephalus Foundation, Inc., 2013). Dr. Stone’s wife confirmed that he displayed this symptom.

**Disease Resemblance**

Due to the increase in cerebral pressure, the brain’s cognitive mental capabilities, like memory, talking, critical thinking, and reasoning can be affected. Since these likewise appear with dementia and other advanced age diseases, specialists often misdiagnose these patients with either Alzheimer’s or Parkinson’s. (Hydrocephalus, 2013) As a result, a diagnosis may be difficult to come by due to the subtle nature of the symptoms. (Normal Pressure Hydrocephalus (NPH), 2013)

**Treatment**

A common treatment is a regulation of the excess fluid by surgically inserting a synthetic tube (shunt) into the brain ventricle. The shunt then carries the liquid from the expanded brain cavity (ventricle) to an alternate part of the body and in Dr. Stone’s case, his abdomen, as pictured below. (Normal Pressure Hydrocephalus (NPH), 2010; Schwartz, 2013)
**Introduction**

Imagine walking and you cannot avoid stumbling even though the ground may be flat and free of obstacles. Then you start to forget how to get home, can no longer retain new information, and become apathetic toward life. That description happens to fit a variety of diseases that include Alzheimer’s, Parkinson’s and dementia. Due to the similarity in presentation, many people never know they suffer from Normal Pressure Hydrocephalus. On ABC’s Grey’s Anatomy, they addressed this issue in an episode in 2009. It was the first time I had seen this condition discussed in mainstream media. Before that, I learned about it from my client, Dr. Charles Stone.

A 70-year-old, very active, retired heart surgeon, Dr. Stone began practicing Pilates in 2005. I began seeing him after his second knee replacement in 2006 and focused his sessions on rehabilitation purposes. About a year later, he noticed that there was a decline in his motor skills specifically regarding his gait which frustrated Dr. Stone not only in our sessions, but also in his daily life. He noticed his Pilates sessions helped him improve his motor skills, though the results were not long lasting. It became so distorted that after numerous doctor’s visits he was diagnosed with Spinal Stenosis of the cervical spine and had corrective surgery, a laminectomy, in hopes of correcting a potentially impinged nerve affecting his gait. I accompanied him to physical therapy during his recovery, observing his progress in a clinical setting, in order to help design a Pilates program when he was discharged. Due to his minimal progress post surgery, Dr. Stone’s Pilates program was modified focusing on his gait and balance with the expectation that his results would gradually improve.

When his gait turned into a shuffle and he showed signs of cognitive decline, Dr. Stone had additional doctor’s visits and was diagnosed with Parkinson’s. Since there is no cure for this
disease, Dr. Stone experimented with hormonal therapies such as L-DOPA. Because his motor skills and cognitive function continued to deteriorate, I had to be sensitive to his worsening symptoms and adjusted his program to a remedial level. After taking L-DOPA for numerous months and showing no signs of improvement, Dr. Stone went back for a series of tests and more doctors’ visits. (Marinis, 2013)

In the end, Dr. Stone was diagnosed with the condition Normal Pressure Hydrocephalus. He had another surgical procedure in 2009, placing a shunt in his brain to redirect the excessive fluid to his abdomen, and immediately began to regain motor activity and cognitive function. There was a dramatic change in his gait post surgery. I saw for the first time in three years an improvement in his quality of life. Dr. Stone finally began to have hope that he would be able to walk normally again with the help of his Pilates sessions. I was able to give him a more thorough program, and began to adjust his modified lessons to a more comprehensive workout. Today I focus on the Fundamental and Intermediate levels using the BASI Block System with modifications specific to Dr. Stone’s condition in hopes to gradually progress him toward more advanced sessions.

**Body**

As a community we discuss how Pilates is a form of mind-body exercise, but we rarely talk about the method’s impact and significance on the mind, or brain, when it is affected by a neurological condition. This is a concept I have had an opportunity to explore from a variety of perspectives during the course of Dr. Stone’s Pilates journey. Early on when his condition began to decline, the doctors surmised that there was a nerve impingement affecting Dr. Stone’s gait, and he was diagnosed with Spinal Stenosis of the cervical spine. In Karen Clippinger’s Spinal Stenosis workshop I learned that it is common for people over the age of 60 to be diagnosed with
Spinal Stenosis without showing symptoms because of how commonly it relates to a congenital condition. A few months after Dr. Stone’s recovery from the laminectomy, which was prescribed to alleviate Stenosis symptoms, his gait declined to a shuffle and he began to demonstrate a loss in cognitive function. No tests provided a conclusive cause of his symptoms, so until an accurate diagnosis could be made, I began to research numerous gait improvement strategies and created a new approach for Dr. Stone’s Pilates sessions. (Kalichman, 2008)

As Dr. Stone’s condition worsened, I followed BASI modification protocols by changing the choreography to make his exercises easier, lightened spring tensions as he began to lose strength, and simplified cues due to his impairment of cognitive function. I also had to forgo my progressive lesson plans and began a slow regression to rudimentary sessions. A few simple exercises in Dr. Stone’s program were balancing on one leg holding onto the Cadillac, kicking a large ball to put into practice the swing cycle of gait, jumping on a mini trampoline to help with the stuck to the floor feeling he had with his legs, as well as a basic relearning of cross lateral walk patterns. In a gait workshop from PhysicalMind Institute, I learned an exercise that was an exaggerated walk. I find this exercise helps many gait abnormalities and highlights the imbalances that could be present, so I gave this to Dr. Stone in hopes to improve his walking. He would take a step and hold the staggered position. Then he would twist toward the forward leg with his arms out at shoulder height. Dr. Stone would rotate his head in the same direction of his spinal twist. He would hold the position for a moment then would repeat it to the other side making his way across the room. Here is a picture of Dr. Stone performing this exercise today. (BASI, 2008)
Unfortunately, these exercises did not improve Dr. Stone’s gait and there was further decline in his cognitive abilities. After seeing a decrease in what he was capable of comprehending and retaining, I simplified Dr. Stone’s cues down to the most basic level. I became creative with how to communicate movement to someone who now had trouble telling himself how to walk, let alone exercise. Explaining to Dr. Stone how to activate his muscles was becoming increasingly difficult and I found myself using classical cues such as “navel to spine,” “chin to chest,” and “shoulders down” because they were broad enough to elicit a muscular response. (Pilates, 1945)

With multitasking nearly impossible, I had to remove breathing cues from the choreography because more than one instruction at a time would confuse Dr. Stone. I felt I had no other choice but to remove the breathing, even though this downplays the direct teachings of Joseph Pilates and one of the Ten Principles in the BASI approach. Instead of overlaying breathing cues within Dr. Stone’s exercises, I created a choreographed breathing warm up. I would have him lie down supine and breathe three dimensionally. I used cues asking him to breathe front to back, left to right and top to bottom; anterior and posterior breathing, lateral breathing and vertical breathing. Since I removed the breath cues from his exercises, I had to assume that Dr. Stone continued to breathe throughout his sessions, which allowed me to resume my focus on simplified movement cues. (BASI, 2008)
Finally, Dr. Stone was accurately diagnosed with Normal Pressure Hydrocephalus. Though difficult to diagnose, he was in the age group for adult onset NPH, displayed all of the symptoms, and unfortunately it took three years to diagnose him with the proper condition. After surgery, there was a remarkable improvement in his gait and cognitive function. Before the diagnosis of NPH, I prioritized exercises with focused hip, knee, ankle strengthening and stretching exercises to rehabilitate his legs after knee surgery. Though, I found that Dr. Stone’s gait responded much better to these exercises after his accurate diagnosis and final surgery. One of the exercises I included in his program was Calf Raises on the Chair in the Footwork BASI Block with a muscle focus of his weakening calves. I felt this exercise was effective for gait because of the objective of calf stretching and strengthening but also including a hip flexor stretch. Calf Raises on the Chair are a multitasking exercise, though simplistic choreographically, which I felt suited Dr. Stone’s needs well. (BASI, 2008)

Another effective exercise was Single Leg Heel on the Reformer in the Footwork BASI Block with a focus on hamstrings and quadriceps. I felt that strengthening each leg independently was wise due to their deterioration, and Dr. Stone would continue to gain hip and knee extensor strength. Cadillac Circles (Down, Up) in the Single Leg Supine category of the Hip Work BASI Block was also another very helpful exercise for Dr. Stone. With a muscle focus of hamstrings and adductors, this exercise aided with his widening and shuffling gait, and has a multipurpose objective with simple choreography. Dr. Stone would connect the Single Leg Supine work with Basic Leg Springs Circles (Down, Up) in order to create unison with his legs. The various leg circle exercises improved his gait with a focus on hamstrings while creating hip extensor strength, adductor control and hip disassociation. (BASI, 2008)
After attending Karen Clippinger’s Gait workshop in 2011, I was able to create an even more comprehensive program for Dr. Stone that I still put into practice today. Using her theories, I focused on side bending, rotation, and extension exercises to regain head, cervical, and thoracic strength and flexibility to further improve his gait. These spinal motions also improved Dr. Stone’s lack of articulation of the cervical and thoracic spine from his laminectomy. He continues to do modified Side Stretch on the Chair resting both feet on a block on the side of the chair in the Lateral Flexion BASI Block. This allows a focus of abdominal obliques with the objective of lateral flexor stretch and abdominal strength with oblique emphasis. (BASI, 2008)

I frequently gave Dr. Stone thoracic extension due to his forward head posture from the laminectomy, but also because of his habit of looking at the ground when his gait became a shuffle. One exercise in the Back Extension BASI Block he did was a modified version of Pulling Straps 1 Long Box Series on the Reformer. Instead of using the ropes, I had Dr. Stone hold onto the frame of the Reformer because a closed chain movement would be easier than an open chain movement. The action of the exercise had a smaller range of motion due to the position of the arms, but also because of his lack of thoracic flexibility. A challenge for Dr. Stone was performing back extension without over powering from his arms. In modified Pulling Straps 1, the muscle focus of back extensor work was still present as well as back extensor and shoulder extension strength, but in a less demanding, more controlled environment. (BASI, 2008)

I felt Dr. Stone should extend his practice outside of the studio to make further progress, so I taught him a few BASI series’ that he could do at home. He enjoys the Pole Standing Series in the Stretches BASI Block and practices them at home with a broom. The spinal motions of
Side Stretch and Spine Twist Standing in this series are very effective because they provide Dr. Stone with feedback where neutral alignment should be while working side bending and rotation to regain head, cervical, and thoracic flexibility to further improve his gait. Dr. Stone is very motivated and arrives early for his sessions to do a warm up with the Ladder Barrel consisting of stretches of the Gluteals, Hamstrings, Adductors and Hip Flexors in the Stretches BASI Block to prepare himself for his session.

Today, Dr. Stone continues to advance and I revisit many of the exercises and modifications carried out shortly after his shunt surgery. A sample class today would be as follows:

**Mat**

**Warm Up**- Pelvic Curl, Spine Twist Supine, Chest Lift, Chest Lift with Rotation

**Reformer**

**Footwork**- Parallel Heels, Parallel Toes, V-Position Toes, Open V-Position Heels, Open Position Toes, Calf Raises, Prances, Single Leg Heel, Single Leg Toes, Prehensile

**Abdominal Work**- Hundred Prep

**Hip Work**- Frog, Down Circles, Up Circles, Openings

**Spinal Articulation**- Bottom Lift, Bottom Lift with Extensions

**Stretches**- Standing Lunge

**Cadillac**

**Full Body Integration 1**- Push Through Series; Sitting Forward, Side Reach

**Arms Standing Series**- Chest Expansion, Hug-a-Tree, Up Circles, Down Circles,
Punching, Biceps
Wunda Chair

Additional Leg Work-Leg Press Standing

Lateral Flexion-Side Stretch (modified)

Back Extension-Swan Basic

Unfortunately, the delayed diagnosis resulted in brain injury from the water pressure build up over time so Dr. Stone will never make a complete recovery. One symptom that arose after the shunt surgery was hearing loss, which makes it difficult to verbally communicate, so I wear a microphone that connects via Bluetooth to Dr. Stone’s hearing aids. Though he continues to improve with gait, he continues to struggle with remnants of other cognitive issues affecting learning and retaining knowledge. It is a two steps forward, one step back process and we will always deal with continual setbacks due to his age and health. Moving forward, my goals for Dr. Stone in the next year are to continue with a gait recovery focus, challenge his balance, and bring back more complex cueing, breathing and choreography. All the while, progressing Dr. Stone to an Intermediate Level BASI Block level workout while continuing to be sensitive to the coordination issues and mental disturbances that will affect him for the rest of his life.

Conclusion

Dr. Stone went down a long and difficult road before his accurate diagnosis of Normal Pressure Hydrocephalus and is finally on the path to a positive physical and cognitive recovery. Because he no longer has to tell himself how to walk, Dr. Stone recognizes daily how the surgery has improved all of his conditions and how Pilates has helped him regain mobility. Now I am able to progress him toward an Intermediate level workout.

Being a part of Dr. Stone’s journey gave me an opportunity to explore a variety of resources and creatively apply different ideas to help improve his condition. This was my first
exposure to the adverse affects a neurological condition can have on one's ability performing Pilates exercises. With the baby boomer generation entering retirement, the aging population is growing rapidly and I believe more instructors are going to increasingly face similar issues to those of my work with Dr. Stone. Going forward, I would like to continue to learn more about traumatic brain injuries in conjunction with Pilates and am excited to hone and develop my skills in this area to share my knowledge with other teachers who encounter a similar circumstance.
Bibliography


Kalichman, L. & Hunter, D. 2008. Diagnosis and conservative management of degenerative lumbar spondylolisthesis. *Eur Spine J*, 17 (327-335)


