OUTPATIENT PHYSICAL THERAPY FOR A PATIENT WITH CHRONIC ATAXIA
SECONDARY TO CEREBELLAR STROKE

A Doctoral Project
A Comprehensive Case Analysis

Presented to the faculty of the Department of Physical Therapy
California State University, Sacramento

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHYSICAL THERAPY

by

Christina Estrem
SUMMER
2015
Student: Christina Estrem

I certify that this student has met the requirements for format contained in the University format manual, and that this project is suitable for shelving in the Library and credit is to be awarded for the project.

Edward Barakatt, PT, PhD

Department Chair

Date

Department of Physical Therapy
Abstract

of

OUTPATIENT PHYSICAL THERAPY FOR A PATIENT WITH CHRONIC ATAXIA SECONDARY TO CEREBELLAR STROKE

by

Christina Estrem

An elderly patient with chronic cerebellar stroke was seen for treatment for physical therapy for 12 sessions from October, 2013 until May, 2014 at an outpatient clinic for patients with neurological pathologies under the supervision of a licensed physical therapist.

The patient was evaluated at the initial encounter and a plan of care was established. Main goals for the patient were improved static and dynamic postural control, speed and endurance with ambulation, and improved level of dependence with functional activities. Main interventions used were task specific training in the form of body weight-supported treadmill training and over-ground ambulation with assistive device, static and dynamic balance training, and the utilization of an individualized home exercise program. The patient achieved the following goals: improved range of motion, balance, functional mobility, aerobic capacity, gait, and postural control during ambulation. The patient was discharged to prior living arrangement (home with spouse) with home exercise program.

Committee Chair

Rafael Escamilla, PhD, PT, CSCS, FACSM

Date

2/21/15
ACKNOWLEDGEMENTS

I would like to acknowledge my family, classmates, and the faculty of Sacramento State University’s Physical Therapy Program for their boundless contributions to my education and composition of this doctoral project. I would specifically like to thank my husband for his unconditional support and constructive criticism throughout my scholastic endeavors. I would also like to acknowledge Dr. Rafael Escamilla for his assistance as my committee chair. I would further like to acknowledge Dr. Katrin Mattern-Baxter for her expertise in neurological rehabilitation. The physical therapy reasoning and interventions displayed in this document were heavily influenced by her guidance.
TABLE OF CONTENTS

Page

Acknowledgements .......................................................................................................... vi
List of Tables ................................................................................................................... vii

Chapter

1. GENERAL BACKGROUND .......................................................................................... 1
2. CASE BACKGROUND .................................................................................................. 4
3. EXAMINATION – TESTS AND MEASURES .............................................................. 10
4. EVALUATION .............................................................................................................. 21
5. PLAN OF CARE – GOALS AND INTERVENTIONS .................................................. 23
6. OUTCOMES ............................................................................................................... 41
7. DISCUSSION .............................................................................................................. 46

References....................................................................................................................... 48
LIST OF TABLES

<table>
<thead>
<tr>
<th>Tables</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Medication</td>
<td>9</td>
</tr>
<tr>
<td>2. Normative Stroke Impact Scale Data for Patients with Chronic Stroke</td>
<td>16</td>
</tr>
<tr>
<td>3. Examination Data</td>
<td>17</td>
</tr>
<tr>
<td>4. Evaluation and Plan of Care</td>
<td>23</td>
</tr>
<tr>
<td>5. Outcomes</td>
<td>41</td>
</tr>
</tbody>
</table>
Chapter 1

General Background

A cerebrovascular accident, more commonly referred to as a stroke, occurs when there is an interruption of the blood supply to the forebrain, hindbrain, or brainstem resulting in tissue death. A stroke usually occurs due to an underlying heart or blood vessel disease, and can manifest as an ischemic or hemorrhagic event. An ischemic event occurs as the result of an obstruction, either a thrombus or an embolus, in a vessel supplying blood to the brain. A hemorrhagic event occurs when a weakening in a blood vessel, likely due to an aneurysm or arteriovenous malformation, ruptures creating ischemia in the tissue supplied by the involved vessel.

Each year nearly 800,000 people experience a new or recurrent stroke in the United States, which accounts for 1 in every 19 deaths. Ischemic strokes are by far the most prevalent representing 87% of all strokes. The remaining 13% are hemorrhagic strokes, which can be subdivided into intracerebral hemorrhagic strokes (10%) and subarachnoid hemorrhagic strokes (3%). An intracerebral hemorrhage (ICH) is one of the most disabling forms of stroke. Greater than one third of patients with ICH will not survive and only twenty percent will regain functional independence.

Strokes in the hindbrain are rare with cerebellar ischemic and hemorrhagic strokes accounting for 1.5% to 3% of all acute strokes. The cerebellum receives its blood via three major arteries: the superior cerebellar artery (SCA), anterior inferior cerebellar artery (AICA), or the posterior inferior cerebellar artery (PICA). An interruption in any
one of these vessels can lead to an infarction of cerebellar or brain stem tissue.\textsuperscript{5}

Furthermore, interruptions in the cerebellar blood supply have higher mortality rates when compared to those of other vascular territories. The increase in mortality is generally due to a concomitant brainstem infarction or compressive hydrocephalus, rather than cerebellar ischemia alone.\textsuperscript{6}

Infarctions of the cerebellum often have diverse clinical manifestations.\textsuperscript{7} The cerebellum is largely responsible for muscle coordination of voluntary movement, maintenance of balance and posture, and motor learning. The coordination of muscle activation is not only important for gross motor movement patterns such as walking, but also for fine motor control like that required for visual acuity and speech. A cerebellar infarction often affects a patient in several ways. In the acute stage, a patient may present with dizziness, nausea and vomiting, unsteady gait, and headache.\textsuperscript{7} These patients should be monitored closely to ensure that edema and subsequent increases in intracranial pressure do not compress surrounding regions of the fourth ventricle, namely the brainstem. Along the road to recovery patients may experience varying levels of motor dysfunction, brainstem damage, hydrocephalus, nystagmus, vertigo, dysarthria, dysphagia and/or dizziness.\textsuperscript{5} Chronically, patients may have a loss of smooth and effective voluntary movement because appropriate coordination and activation of agonists, antagonists, synergists, and fixator muscles has been lost. Ataxia is the result of this loss of coordination, and is often accompanied by decreased muscle strength, a disorder of muscle tension, or involuntary movements. Overall, this will affect
ambulation status, postural control and equilibrium, ability to transfer, oculomotor control, oropharyngeal control for talking and swallowing, and performance of activities of daily living. Impairments are often present bilaterally with stronger impairments displayed ipsilateral to the side of the cerebellar lesion. Research has shown differences in clinical presentation, clinical course, and prognosis depending on the cerebellar artery that was compromised.

Risk factors for stroke can be divided into two categories: modifiable and non-modifiable risk factors. Non-modifiable risk factors include: male gender; age greater than 55; ethnicity including Asian/Pacific islander, African American, or Hispanic; the presence of a vascular malformation, neoplasm, or amyloid angiopathy; a history of trauma; and a family and personal history of stroke, heart disease or diabetes. Men are twice as likely to experience a cerebellar stroke than women. Most strokes occur in individuals over the age of 65. The risk of having a stroke increases after the age of 55, and the possibility of occurrence doubles every ten years beyond 55.

Modifiable risk factors include the presence of comorbidities such as diabetes, hypertension, atrial fibrillation, hyperlipidemia, high cholesterol, and vascular stenosis. Making sure the aforementioned comorbidities are controlled reduces the risk of stroke. Behavioral risk factors are also considered modifiable and include obesity, physical inactivity, smoking, alcohol consumption, illicit drug abuse, and the use of blood anti-clotting medication. A reduction in weight, comorbidity status, or the cessation of harmful behaviors can significantly reduce the risk of stroke.
Chapter 2

Case Background

Examination – History

The patient who participated in this physical therapy case study was a 69-year-old male who experienced a hemorrhagic stroke of the cerebellum in July of 2010. The stroke resulted in a cerebellar lesion and manifested in widespread motor control deficits. The patient’s chief complaint was his inability to walk independently. The patient primarily used a wheelchair for mobility, which he maneuvered independently on level ground by pulling himself with the use of his legs. He also ambulated with a front-wheeled walker with moderate assistance when time and assistance allowed. The patient was dependent on the assistance of his family (spouse and daughter) and a hired caregiver to perform his activities of daily living. He was no longer employed due to his disability.

The patient was suspected to have had an arteriovenous malformation that contributed to the onset of the stroke. Acutely, the patient slipped into a state of semi-consciousness and could respond to small motor commands. He could not speak, eat, or swallow, and he was placed on a tracheotomy tube for mechanical ventilation and required a nasogastric tube (NG) for nutrition. Doctors surgically removed an aspect of his skull and implanted a drain for excess fluid to minimize intracranial pressure. He remained in the intensive care unit (ICU) for two weeks before he was taken off ventilation. At this point, weak gross limb movement returned along with voluntary bowel and bladder function.
The patient’s road to recovery included extensive stays in the ICU, a neurologic observational unit, a neurologic rehabilitation facility, and several surgeries to address hydrocephaly primarily around the cerebellum. The first year after his stroke the patient was in and out of the hospital. He repeated several cycles of surgery followed by time in the ICU, an acute care facility, and finally returning to a neurologic rehabilitation unit. He had ten surgeries, mostly to address a shunt malfunction, since his stroke in July of 2010. Throughout this process he received extensive physical, occupational, and speech therapy in in-patient, outpatient, and home health settings.

At the time of his initial evaluation for his current course of physical therapy (PT) the patient could not swallow without risk of asphyxiating, so he received nutrition and medication through a percutaneous endoscopic gastrostomy (PEG) tube. He was able to ambulate with minimal to moderate assistance from his caretakers or a therapist. His speech at best was 60% intelligible per his speech therapist. He reported a plateau in his physical rehabilitation of gross motor skills. However, he was very motivated to participate in therapy and believed he could regain his ability to walk.

The patient was utilizing outpatient physical therapy services in addition to pro bono physical therapy services at the time of this case study. He received speech therapy to address his dysphagia and dysarthria. The patient received PT services via a local outpatient clinic and local pro bono clinics. Physical therapy students visited his home every weekday to assist with rehabilitative exercises. He has tried weight-supported treadmill training (WSTT) to improve postural control during gait, but mostly practices
over-ground training with a 2-wheeled walker with sliders with contact-guarding to mod-
assistance from his home-health therapists.

This patient was identified as a fall risk. His daughter reported that he had not
fallen in the four months prior to starting this bout of physical therapy. He had
experienced four falls in the previous year, most frequently from his wheelchair. His
family further reported he previously fell multiple times a week due to severe ataxia, but
occurrence of falls had become less and less frequent.

The patient is married to a supportive spouse who is the primary caregiver. The
spouse recently retired and has been able to dedicate more time to the care of her
husband. They also pay an additional assistant to come to the house daily and help
primarily with the patient’s grooming needs. The hired caregiver also takes the subject to
and from his numerous healthcare appointments as needed. The patient and his wife have
one daughter who recently moved out of the family home. While living with the patient,
the daughter was extremely involved in providing care and assistance for him.

Prior to the stroke, the patient worked as a political advisor. He also led a more
active lifestyle. Since the stroke, the patient had been unable to resume any work
activities due to his inability to effectively communicate and perform motor tasks.

The patient’s general goals were to become more independent with ambulation
and improve the distance he can walk without rest. Furthermore, he wanted to return to
work, but realized this was an unlikely outcome. Overall, the patient and his family
understood the importance of an active lifestyle, and were eager to maximize his ability to be independent and active.

**Systems Review**

The patient had the following systems affected by his stroke: musculoskeletal, neurological, and cardiovascular/pulmonary systems. The patient’s integumentary system was checked and cleared showing no signs of impairment. Problems of the gastrointestinal system were brought to my attention during the initial evaluation. The patient’s stroke resulted in dysphagia, so he received implantation of a gastric feeding tube. The patient was under the care of a gastroenterologist for the management of this impairment.

**Home Evaluation**

The patient resided in a two-story single family home on the first floor. He had no need to utilize the second floor but had admitted to crawling up and down the stairs when he was home by himself. The patient used the front door to enter and exit the home. The entrance was wheelchair accessible via a ramp from the porch, although it was too steep for the patient to navigate independently.

The patient struggled with maneuvering through narrow doorways within the home. The door widths were slightly wider than the width of his wheelchair. There were a few loose rugs in the common room that were identified as tripping hazards. The subject had a queen bed that was 26” tall. He demonstrated transfers into and out of bed and into and out of a recliner with the use of transfer poles that had been installed in the
bedroom. The subject was unable to reach and open any closets or windows. His bedroom also had an accessible night table with a telephone for emergencies.

The patient was able to fit the walker and wheelchair in the bathroom. He required moderate assistance for toileting and showering. The patient primarily utilized a bedside commode independently. The patient showered daily with moderate assistance and the utilization of a shower seat.

**Examination – Medications**

Medications taken at the time of the initial evaluation are listed in Table 1. The patient was prescribed Aleve to address the symptoms of osteoarthritis in multiple joints. The patient reported an improvement in symptoms since receiving the prescription. He was prescribed Prozac to address symptoms of depression. The patient and family reported a decrease in depressive tendencies with prescription compliance. He was prescribed Fosamix to address osteoporosis, which was a concern due reduced weight-bearing activities. The patient was prescribed Protonix to address complications from the gastric feeding tube and gastric esophageal reflux disease (GERD). The patient’s medical team monitored his medication consumption.
Table 1.

<table>
<thead>
<tr>
<th>MEDICATION(^{14})</th>
<th>DOSAGE</th>
<th>REASON</th>
<th>PT SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pantoprazole</td>
<td>40 mg Tab 1x daily per g-tube</td>
<td>Used to treat GERD &amp; gastric feeding tube complications</td>
<td>Headache, dizziness, nausea, vomiting, joint pain, gas</td>
</tr>
<tr>
<td><em>Fosamax</em></td>
<td>70 mg Tab once a week per g-tube</td>
<td>Treat and prevent osteoporosis (bisphosphonates: prevent bone breakdown and increase density)</td>
<td>Nausea, stomach pain, constipation, diarrhea, gas, bloating, headache, dizziness, swelling of the joints, hands or legs</td>
</tr>
<tr>
<td><em>Prozac</em></td>
<td>20mg Tab 1x daily per g-tube</td>
<td>Depression (increases serotonin levels)</td>
<td>Nervousness, nausea, dry mouth, sore throat, drowsiness, weakness, uncontrollable shaking of a body part, loss of appetite, weight loss, excessive sweating</td>
</tr>
<tr>
<td><em>Aleve</em></td>
<td>220 mg tablets twice per g-tube</td>
<td>Arthritis - relief of symptoms</td>
<td>Constipation, diarrhea, gas, excessive thirst, headache, dizziness, lightheadedness, drowsiness, difficulty falling asleep or staying asleep, burning or tingling in the arms or legs, cold symptoms, ringing in the ears, hearing problems</td>
</tr>
</tbody>
</table>
Chapter 3

Examination – Tests and Measures

The patient’s deficits were categorized and measured using the International
Classifications of Functioning, Disability and Health (ICF) Model.\textsuperscript{15} The following body
structure or function tests and measures were used with the patient to identify
impairments: Scale for the Assessment and Rating of Ataxia (SARA), Dix-Hallpike
maneuver, the Roll-Test and the Modified Clinical Test of Sensory Interaction on
Balance (mCTSIB). Strength, range of motion (ROM), sensation, and proprioception
were screened for major deficits at the initial encounter. The following activity level tests
and measures were used to identify activity limitations: the Functional Reach Test (FRT),
Six Minute Walk Test (6MWT), the Ten Meter Walk Test (10MWT), and the Timed Up-
and-Go test (TUG). The Stroke Impact Scale (SIS) is a participation measure that was
used to establish a baseline measure for restrictions and to monitor change.

The SARA is a quantitative assessment of ataxia. An accurate assessment of
ataxia is important for identifying appropriate supplementary tools for walking, to
determine the most effective treatment, and to assess safety.\textsuperscript{16} The SARA assesses
cerebellar function in the following eight areas: gait, stance, sitting, speech, finger-chase
test, nose-finger test, fast alternating movements and heel-shin test. The total score ranges
from 0 (no ataxia) to 40 (severe ataxia). An article by Kim et al was used to report
psychometric data and cut-off scores for the SARA.\textsuperscript{17} For the assessment of stable
cerebellar lesions, the SARA scale has been shown to be a valid and reliable measure of
ataxia. No differences in the SARA scores were found in terms of stroke type or lesion location (p>0.05) indicating the measure’s effectiveness in measuring ataxia with several types of lesions. The inter-rater reliability and test-retest reliability are both high with intraclass correlation coefficient (ICC) values of 0.98 and 0.99, respectively. Internal consistency is also high with a Cronbach’s alpha of 0.97. To support construct validity, the SARA score increased with the more disabled individuals (P < 0.0001). In addition, SARA scores were inversely correlated with the Barthel index (r= -0.63, P < 0.0001) and the Korean version of the Modified Barthel Index (r=-0.792, p<0.01). The SARA scale was also weakly correlated with disease duration (r=0.44, P< 0.001).

The test is not only good at identifying a patient’s level of ataxia, but it also corresponds well with gait status and activities of daily living (ADLs) dependency. Increasing SARA scores correlate with decreasing levels of ambulation. Patients who could ambulate with a walker independently were correlated with SARA scores below 12.25. The patient in this case study required assistance with walker ambulation, which was accurately reflected with his SARA score of 21. With regard to ADL functional levels (total dependence, severe dependence, maximal dependence, moderate dependence, and minimal dependence), SARA scores were also significantly correlated with ADL functional levels scores (p<0.01). The performance of daily living activities requiring moderate dependence were categorized by SARA scores at or below 14.25, and maximal dependence at or above 23.
The Dix-Hallpike is a body structure and function test used to diagnose benign paroxysmal positional vertigo (BPPV) in the posterior semicircular canal. The patient is taken through a series of four positions on a treatment table. The test is considered positive if the patient displays upward and ipsitorsional nystagmus or reports symptoms of vertigo. The Dix-Hallpike test is the standard from which the diagnosis of posterior semicircular canal BPPV is made. For the Dix-Hallpike test, the estimated sensitivity was 79%, specificity was 75%, positive likelihood ratio (LR) was 3.17, negative LR was 0.28. These particular values resulted in a small increase or a small decrease in the likelihood that the patient had BPPV, and therefore does not allow a practitioner to be confident in making or ruling out this diagnosis. The patient did not display any symptoms or nystagmus with the Dix-Hallpike maneuver.

The Roll Test is a body structure and function test used to diagnose BPPV in the horizontal canals. Typically, a patient that is suspected to have BPPV will be tested with the Dix-Hallpike initially due to the prevalence of posterior canal BPPV. If that is negative, the examiner then administers the Roll Test. During this test, the patient is supine with the neck flexed 20 degrees and the head is rotated 90 degrees to the right with the position held for up to one minute. The test is repeated to the opposite side. The presence of nystagmus and patient reported vertigo indicate a positive test. Psychometric data is not available; however, the Neurology section of the American Physical Therapy Association’s Vestibular Taskforce states that this measure is reasonable to use even though there is limited literature on the effectiveness of this measure. This test lacks
psychometric data, it is widely used because it is one of the only clinical tests for diagnosing horizontal canal BPPV.

The modified Clinical Test of Sensory Interaction and Balance (mCTSIB) is an ICF activity domain outcome measure that provides the clinician with a means to quantify a patient’s postural control under various sensory conditions. The test includes the following 4 conditions: (1) stand on firm surface with the eyes open, (2) stand on firm surface with the eyes closed, (3) stand on compliant surface (foam) with the eyes open, and (4) stand on compliant surface (foam) with the eyes closed. The patient is scored on their performance during 30-second trials in each condition. Although clinically utilized for patients with stroke, no SEM, MDC or MCID has been established for this patient population. For community dwelling adults, there are cut-off scores for identifying fallers. A composite score < 260 seconds computed by summing all three 30 second trials for each of the six conditions has a specificity of 90% and a sensitivity of 44% for identifying fallers. If the average score is below 81 seconds in compliant surface conditions, the risk of falling is increased (age adjusted odds ratio = 8.67 using a 95% confidence interval). This test was primarily used as an outcome measure to monitor changes in static balance. Refer to Table 3 for initial test results.

The FRT is a performance measure used to assess a patient’s stability by measuring the maximum distance an individual can reach forward while standing in a fixed position. This is an activity level measure based on the ICF model. The SEM for patients with stroke is 2.45 cm. The MDC for the FRT for a patient with chronic
cerebellar stroke has not been established, but the MDC\textsubscript{95} for patients with subacute stroke is 6.79 centimeters (cm). The MCID has not yet been established. Furthermore, an excursion of less than 15 cm has been established as a cut-off for fall risk for patient’s post-stroke. This test was used as a prognostic test for assessing fall risk and as an outcome measure to assess changes in balance. The patient in this case study was had an 8cm excursion at initial testing. The Neurology Section of the American Physical Therapy Association’s Stroke Taskforce highly recommends the use of this outcome measure with the acute, subacute, and chronic patient with stroke.

The 6MWT is an ICF-activity level outcome measure and is used to assess the distance a patient can walk over 6 minutes as a sub-maximal test of aerobic capacity/endurance. This test could also be considered a body-structure and function test as it measures cardiopulmonary and muscular endurance. A patient is given six minutes to cover as much distance as possible at either a self-selected or fast speed. Assistive devices can be used, but should be kept consistent from test to test. Individuals should be able to ambulate without assistance to complete this test. Flansbjer et al identified the smallest real difference percentage to be 13\%, which has been used to show meaningful change in the 6MWT in patients with chronic stroke. The minimum distance an elderly individual needs to be able to walk to be considered “functional in the community” is 360 meters during testing. The Stroke EDGE taskforce highly recommends this test for acute, subacute, and chronic patients with stroke in all settings. Refer to Table 3 for testing results.
The 10MWT is an outcome measure that quantifies functional mobility and gait and is in the ICF activity domain. The test assesses walking speed in meters per second by measuring the time it takes an individual to walk at a normal pace or fastest speed possible over a 10-meter (m) distance. The performance can be averaged over 3 trials. There is no MCD for patients with chronic stroke. The MCID for stroke patients is 0.06 m/s, and for a substantial meaningful change it is 0.14 m/s. Gait speed has further been shown to have prognostic value for determining ambulation ability and quality of life. Patients who ambulate at a speed slower than 0.4 m/s, between 0.4 m/s and 0.8 m/s, and > 0.8 m/s were more likely to be household ambulators, limited community ambulators, and community ambulators, respectively. The patient in this case study was designated as a household ambulator at initial testing based on gait speed.

The Timed Up and Go (TUG) is an ICF activity level measure that assesses mobility, balance, walking ability, and fall risk in older adults. For patients with chronic stroke, the SEM is 1.14 seconds, the MDC is 2.9 seconds, and the MCID has not been established. The TUG can be used as a prognostic measure for fall risks. Fourteen seconds is the cut-off score for fall-risk in older patients with stroke, and is validated with a positive predictive value of 59%, and a negative predictive value of 72%. The patient in this case study scored well above the cut-off for fall risk with an initial test time of 43.6 seconds. This means that this patient had a 59% probability of experiencing a fall. The
Stroke EDGE taskforce again highly recommends this test for acute, subacute, and chronic patients with stroke in all settings.\textsuperscript{25}

The Stroke Impact Scale is considered a participation and activity level outcome measure to assess health status following a stroke. It is a 59-item measure with the following 8 domains: strength, hand function, ADL/IADL, mobility, communication, emotion, memory and thinking, and participation/role function. Scores range from zero (no recovery) to one hundred (full recovery). The MDC\textsubscript{95} for patients with chronic stroke have been established for the following domains: strength = 24.0, ADL/IADL = 17.3, mobility = 15.1, and hand function = 25.9. The MCID\textsubscript{95} for patients with chronic stroke have been established for the following domains: strength = 9.2, ADL/IADL = 5.9, mobility = 4.5, hand function = 17.8.\textsuperscript{33} See table 2 for normative data for patients with chronic stroke.

Table 2

<table>
<thead>
<tr>
<th>Normative Stroke Impact Scale Data for Patients with Chronic Stroke</th>
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<tbody>
<tr>
<td><strong>SIS DOMAIN</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td><strong>Strength</strong></td>
</tr>
<tr>
<td><strong>Memory</strong></td>
</tr>
<tr>
<td><strong>Emotion</strong></td>
</tr>
<tr>
<td><strong>Communication</strong></td>
</tr>
<tr>
<td><strong>Activities of Daily Living/Independent Activities of Daily Living</strong></td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
</tr>
<tr>
<td><strong>Hand Function</strong></td>
</tr>
<tr>
<td><strong>Social Participation</strong></td>
</tr>
</tbody>
</table>
Table 3
Examination Data

<table>
<thead>
<tr>
<th>Measure/ Observation</th>
<th>Action</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensory and Kinesthesia Testing</strong></td>
<td>Sharp-dull discrimination and proprioception</td>
<td><strong>Right</strong>&lt;br&gt;No sensory abnormalities&lt;br&gt;No deficits in flexion/extension discrimination in ankle or knee, but mild impairment in 1st MTP flexion extension discrimination.</td>
</tr>
<tr>
<td><strong>Upper Extremity ROM, Volitional Control, and Coordination</strong></td>
<td>Screened combined functional movements for shoulder ROM.</td>
<td><strong>Right</strong>&lt;br&gt;ROM within functional limits.&lt;br&gt;Patient is able to demonstrate volitional control of all upper extremity joints, however, tremors were present and became intensified toward the EROM for shoulder abduction and flexion. Tremors present at &gt; 100° of shoulder flexion and abduction.&lt;br&gt;(+) Dysmetria</td>
</tr>
<tr>
<td><strong>Lower Extremity ROM, Volitional Control, and Coordination</strong></td>
<td>Screened functional movements for hip, knee, ankle, and toe ROM.</td>
<td><strong>Right</strong>&lt;br&gt;Patient within functional limits unless otherwise noted&lt;br&gt;• HE:-5°&lt;br&gt;• DF:0-5°&lt;br&gt;During Functional ROM testing, patient was observed to have loss of smooth coordinated muscle control with increasing degrees of hip flexion beyond 90° and external rotation beyond 15°.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+) Dysemetria</td>
</tr>
<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td><strong>Strength Lower Extremity (LE)</strong></td>
<td><strong>Manual Muscle Testing of the Lower Extremity.</strong></td>
<td>Strength was 5/5 unless otherwise noted</td>
</tr>
<tr>
<td></td>
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<td>Ankle</td>
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</table>

**Vestibular Function & Balance**

<table>
<thead>
<tr>
<th>Dix Hallpike or Roll Test</th>
<th>mCTSIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. feet 3 inches (in-step to in-step) apart: 30s</td>
<td></td>
</tr>
<tr>
<td>b. feet 3 inches apart eyes closed: 10s</td>
<td></td>
</tr>
<tr>
<td>c. Pt. is unable to perform the variable of the test on foam eyes open</td>
<td></td>
</tr>
<tr>
<td>d. Pt. is unable to perform the variable of the test on foam eyes closed</td>
<td></td>
</tr>
</tbody>
</table>

The patient in this case study was unable to complete the compliant surface condition, thus he is considered to be at an increased risk for falls.

**Semi-Tandem Stance**

| Patient stood with feet 3 inches apart (in-step to in-step) |
| Eyes open: 10s |
| Eyes closed: 3s |

**Posture (Standing)**

Patient had the following obvious postural deviations:
Forward head, increased thoracic kyphosis, rounded/protracted shoulders, decreased lumbar lordosis, bilateral medially facing patella, increased hindfoot valgus, and increased postural sway.

**Ataxia**

Measured with the Scale for Assessment and Rating of Ataxia 8 items graded with a total score ranging from 0 (no ataxia) to 40 (severe ataxia)
- Gait (score 0-8): 6
- Stance (score 0-6): 3
- Sitting (score 0-4): 0
- Speech disturbances (score 0-6): 4
- Finger chase (score 0-4): Right 2; Left 2
- Nose-finger test (score 0-4): Right 2; Left 2
- Fast alternating hand movements (score 0-4): Right 2; Left 2
- Heel-shin slide (score 0-4): Right 2; Left 2

TOTAL: 21 indicates patient is between moderate and maximal dependence for daily living activities, and does not meet the cut-offs for independent ambulation (independent gait, Q-cane gait, walker gait,
# Observational Gait Analysis

Patient ambulates with front-wheeled walker (FWW) and contact guarding
- Excessive trunk flexion
- Decreased knee flexion in swing L>R
- Minimal to no hip extension in stance
- Patient rarely reaches toe-off on either foot
- Exaggerated heel strike on L
- Decreased step length, L>R
- Ataxia apparent on both lower extremities, L>R

## Activity Limitations

### Functional Reach
Assessed with the Functional Reach Test: 8 cm excursion (increased fall risk less than 15 cm) 22

### Gait Speed
Assessed with the 10 Meter Walk Test: 0.3 m/s (household ambulator) 28

### Aerobic Capacity during Ambulation
Assessed with the 6 Minute Walk Test by counting the number of stumbles throughout the testing period
- 18 with a FWW with sliders
- 8 with Reverse Kaye Walker

Distance
- Front Wheeled Walker: 240 ft. (360 meters is cut-off to be considered functional in community) 25
- Kaye Walker: 300 ft. with Reverse Walker (RW)

### Impaired Functional Mobility and Postural Control
Assessed with TUG: 43.6s with Front Wheeled Walker

## Participation Restrictions

### Patient is Unable to Work and Feels Restricted in His Roles as a Father/Husband
Assessed with the Stroke Impact Scale (SIS):
- Strength: 55
- Memory: 70
- Emotion: 70
- Communication: 40
- ADL/IADL: 50
- Mobility: 45
- Hand function: 50
- Social participation: 35

### Reduced Community Outings
Patient requires assist x 1 with ambulation
Patient mostly utilizes wheelchair, and often is dependent on family member or caretaker for mobility (push him in chair) due to slow mobility and inability to navigate uneven terrain.

---

ROM = Range of Motion
EROM = End Range of Motion
HE = Hip Extension
KE= Knee Extension
DF= Dorsiflexion
Had= Hip Abduction
Had= Hip Adduction
PF= Plantar-flexion
S= Second(s)
L= Left
R= Right
TUG= Timed Up-and-Go
ADL= Activity of Daily Living
IADL= Instrumental Activity of Daily Living
m= meter(s)
cm= centimeter(s)
ft.= feet
Chapter 4

Evaluation

Evaluation Summary

The patient was a 69-year-old male 4 years post hemorrhagic stroke that primarily affected the cerebellum. The patient made functional improvements since his stroke, but was still dependent on another person for ambulation and required between moderate and maximal dependence with daily activities. The patient was evaluated with strength, sensory, and ROM testing, SARA scale, FRT, 10MWT, 6MWT, TUG, and SIS and had the following findings: found to have impaired motor control, decreased strength, impaired aerobic capacity and endurance, diminished postural control, decreased functional mobility, dependence in activities of daily living and with ambulation, and self-perceived restricted social functioning.

Diagnostic Impression

The patient presented with a lack of motor control and strength, impaired ROM, impaired aerobic capacity, impaired postural control in stance and with ambulation, and limitations with walking speed and endurance. This was consistent with the medical diagnosis of hemorrhagic stroke, which resulted in problems at the body structure and function, activity, and participation levels of the ICF model.

Physical Therapy Guide Practice Pattern

- 4B: Impaired Posture
• 5D (primary): Impaired Motor Function and Sensory Integrity Associated With
Non-Progressive Disorders of the Central Nervous System - Acquired in
Adolescence or Adulthood

• 6B: Impaired Aerobic Capacity/Endurance Associated With Deconditioning

**G-Codes**

• Mobility: Walking & Moving Around current: G8978; Modifier: CM: 80-99%
impaired based on the patient’s performance on the 6MWT
  o The mean distance in meters by age for community dwelling adults is 572m. The patient in this case study walked 73 m at initial testing. When compared to the norm for his age, the patient was found to have an 87% deficit from mean walking distance for community dwelling adults.

• Changing & Maintaining Body Position: G8981; Modifier: CK 40-59% impaired
  o The cut-off for determining fall risk in patient post stroke is 15 cm. This patient had a functional reach of 8 cm at initial testing. This patient had a 47% deficit from the fall risk cut-off.24
## Chapter 5

### Plan of Care – Goals and Interventions

#### Table 4

Evaluation and Plan of Care

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>PLAN OF CARE</th>
<th>Planned Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short Term Goals</td>
<td>Long Term Goals</td>
</tr>
<tr>
<td></td>
<td>4 weeks</td>
<td>12 weeks</td>
</tr>
</tbody>
</table>

### BODY FUNCTION OR STRUCTURE IMPAIRMENTS

**Upper Extremity ROM & Volitional Control and Coordination**

| N/A | N/A | Dysmetria and tremors were not addressed as they are lasting effects of cerebellar lesion. Patient was instructed in ways to adapt environment to minimize effects of dysmetria and tremors, such as decreasing excursion of reach for objects, as when typing on a keyboard and increasing stability of assistive device (see interventions below) |

**Lower Extremity ROM & Volitional Control and Coordination**

- Maintain current AROM & PROM in the lower extremity joints
- Patient will be able to demonstrate stretching exercises without cueing or set-up assistance
- Patient will obtain 10° of active DF

- Patient will reach 0° of hip extension bilaterally
- Patient will obtain 15° of dorsiflexion bilaterally

Dysmetria and tremors were not addressed as they are lasting effects of cerebellar lesion. Patient was instructed in ways to adapt environment to minimize effects of dysmetria and tremors. (C) Patient performed static stretches for 3x30” holds twice daily. Incorporated into home exercise program (HEP).

- Hip extensors: patient performed kneeling lunge at side of bed emphasizing anterior
bilateral pelvic rotation

- DF: small standing lunge with towel roll under forefoot of back foot

(C) Restored accessory motion of the hip and the talocrural joint by performing joint glides. Utilized grade III mobilizations with 60-second oscillations. Usually performed 4 repetitions if tolerated

- Hip extension (patient prone): posterior to anterior joint glides with force applied over the proximal femur

- Ankle DF (patient supine) while an anterior to posterior force was applied over the talus

- Ankle PF (patient prone) posterior to anterior force applied to the talus through the calcaneus

(E) Educate caregivers and instruct home health providers in PROM, AAROM, and AROM exercises.

Contract-relax exercises were utilized initially in the clinic and incorporated into the HEP to be performed with home-health therapists. The subject alternated between 5-second agonist contractions with 20-second agonist stretch-holds. This exercise was repeated at least three times, or until no further gains were made in hip flexor and DF length. Mobilizations were followed by static stretching, which were then followed by gait/aerobic
Interventions to actively utilize newly gained ROM. After three weeks of performing joint mobilizations, contract relax techniques, and static stretching under therapist supervision, these techniques were discharged to the HEP so the patient could spend more time in the clinic on locomotor training.

<table>
<thead>
<tr>
<th>Decreased Strength LE</th>
<th>Maintain LE strength at a 4/5 throughout LE</th>
<th>Maintain LE strength at a 4/5 throughout LE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased Strength LE</td>
<td>Maintain LE strength at a 4/5 throughout LE</td>
<td>Maintain LE strength at a 4/5 throughout LE</td>
</tr>
</tbody>
</table>

Strength deficits in the hip add, add, and the foot DF and PF are likely due to complications from cerebellar damage resulting in incoordination and disuse atrophy. Limited focus was placed on isolated muscle group strengthening, and more focus was placed on utilizing the overload principle during functional activities such as transfers and walking. (C&E) Closed chain exercises were inserted into the patient’s HEP. Kitchen sink exercises, where the patient can performed open chain hip add, add, and partial squats to be performed until fatigue. The patient was also instructed on how to perform full sit-to-stands until fatigue at the kitchen sink.

2 sets, 3x weekly (no more than every other day) under the supervision of student physical therapist or trained caregiver.
| Impaired Balance | Increase static balance as measured by the number of seconds the patient can last on each level of the mCTSIB  
- feet 2 inches apart: 30s  
- feet 2 inches apart eyes closed: 15s  
- No improvements expected for foam parameters  
Patient will be able to hold ½ tandem stance with feet 3 inches apart  
- EE: 20s  
- EC: 10s | Increase stance times on the mCTSIB to 30-second for both eyes open and eyes closed parameters on solid ground with feet 1 inch apart  
- No improvements expected for foam parameters  
Patient will be able to hold ½ tandem stance with feet 2 inches apart  
- EE: 30s  
- EC: 15s | Interventions were aimed at improving postural control during static and dynamic stance with decreased base of support and varying sensory input (eyes open/eyes closed).  
Balance training was performed with the balance bars or in the LiteGait in the clinic and at the kitchen counter under the supervision of a caretaker at home. The patient stood with feet shoulder width apart (unless otherwise stated) with equal weight on both feet and arms relaxed at side.  
(C&E) To address the patient’s static balance, he was instructed to perform standing balance activities up to 30 seconds, 3 times daily. He was instructed to fold his arms across his chest and stand with his feet in the same plane as close together as possible. He then performed this same activity for similar sets and repetitions with his eyes closed. The patient was instructed to progress this activity by decreasing his stance width and then progressing to increasing tandem stance.  
(C&E) The next set of activities address the patient’s limited cone of stability and lack of dynamic postural control. He performed these activities near a counter. During stance, he performed weight shifts with ankle strategies in anterior to posterior direction and hip strategies in a medial to lateral
27

direction while stabilizing his gaze forward on a target (the letter E). He was further instructed to slowly shift his weight forward, attempting to touch the counter with the front of his thighs with shoulders coming forward. He was further instructed to slowly return to the midline position and repeat. He was not allowed to bend at the hips. All movement was targeted at the ankles. This activity was to be repeated 10 times, once daily. It was progressed by introducing 3-second pauses at the extremes of the weight shifts and then further progressed by having the patient perform with eyes closed (with fingertips on counter as needed). He was instructed to further progress exercises by narrowing his base of support when the activity was no longer challenging.

<table>
<thead>
<tr>
<th>Standing/Seated Posture</th>
<th>Patient will demonstrate increased postural awareness with performance of corrections upon cueing</th>
<th>Patient will demonstrate increased postural awareness with performance of self-corrections without cueing</th>
<th>(C&amp;E) Patient was instructed on how to engage postural muscles for improved posture while seated and standing with manual cueing for facilitation. Seated: erector spinae, scapular adductors and depressors, lower cervical extensors, upper cervical flexors (deep), and muscles to engage anterior pelvic tilt. Stance: All of the above plus hip extensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased Cardiovascular and Pulmonary Endurance</td>
<td>Increase distance patient can ambulate with FWW and contact guarding without rest. This is measured by 6MWT.</td>
<td>Increase distance pt. can ambulate with FWW and contact guarding without rest. This is measured by the 6MWT.</td>
<td>(C) The intervention to increase aerobic endurance focused on increasing the dosage of walking tolerated utilizing Lite Gait system and over</td>
</tr>
</tbody>
</table>
the 6MWT. From 240'→280' with no rest periods
With RW:
300'→325'

>300'
With RW: >400'
ground ambulation with a RW. Since the patient required a rest break after four minutes during the 6MWT, BWSTT started with four-minute intervals until the patient felt comfortable walking for longer bouts. BWS was minimal, and was more in place as a safety harness to eliminate the risk of falls. Gait speed was set at 0.3m/s initially based on 10MWT performance. The patient was unsuccessful in utilizing assistive devices during this intervention.

(E) & (C) This activity was often followed by or replaced with over ground ambulation with the reverse walker as the course of therapy progressed, and was incorporated into the HEP by issuing the patient a loaner RW. The patient was instructed to walk with home therapists daily for increasing distances as tolerated.

<table>
<thead>
<tr>
<th>ACTIVITY LIMITATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired functional reach</td>
</tr>
</tbody>
</table>
| (C) Functional reach improvements were mostly addressed with static and dynamic balance training by challenging the limits of his cone of stability, reactive control, and practicing control with postural changes (please refer to interventions section). The Balance Master software and force plate were also utilized for two sessions for a maximum of ten-minute bouts (please see Interventions that Changed for more information). (C) The patient had the following exercise incorporated into his HEP in addition to his previous balance exercises:
• Standing at the kitchen counter for support, the |
The following interventions were utilized to address limitations in gait speed. (C) The balance, strengthening, and ROM exercises will help to enhance gait mechanics and, subsequently, gait speed. However, task specific training with high volumes of repetition was the targeted intervention for improving gait speed. (C) A RW was introduced to the patient, as mentioned previously, for over ground locomotor training. The RW proved to be the preferential assisted device for the patient during ambulation. Walking with a RW was incorporated into the HEP under the aerobic training (progressively more intense walking over-ground with RW and contact guarding from home-health professional). The variable that should be progressed with this goal in mind is walking speed. As long as the patient can tolerate with proper form and control, the speed of walking should be progressed as tolerated. The patient was instructed on how to time himself set distances to ensure he is challenging his pace. (C) Walking with WSTT (as described above) was also utilized to improve walking speed. (See Interventions that Changed).

| Gait speed | 1. Increase efficiency of gait mechanics as evidenced by the improvements in the 10MWT | 1. Increase efficiency of gait mechanics as evidenced by the 10 MWT | The following interventions were utilized to address limitations in gait speed. (C) The balance, strengthening, and ROM exercises will help to enhance gait mechanics and, subsequently, gait speed. However, task specific training with high volumes of repetition was the targeted intervention for improving gait speed. (C) A RW was introduced to the patient, as mentioned previously, for over ground locomotor training. The RW proved to be the preferential assisted device for the patient during ambulation. Walking with a RW was incorporated into the HEP under the aerobic training (progressively more intense walking over-ground with RW and contact guarding from home-health professional). The variable that should be progressed with this goal in mind is walking speed. As long as the patient can tolerate with proper form and control, the speed of walking should be progressed as tolerated. The patient was instructed on how to time himself set distances to ensure he is challenging his pace. (C) Walking with WSTT (as described above) was also utilized to improve walking speed. (See Interventions that Changed). |
| Gait mechanics | 2. Introduce the patient to a RW | 2. Patient will obtain or be in the process of obtaining appropriate assistive device | (C) The balance, strengthening, and ROM exercises will help to enhance gait mechanics and, subsequently, gait speed. |
| Gait mechanics | 3. Patient will utilize appropriate adaptive equipment to help normalize gait patterns. | 3. Have patient regularly utilizing an assistive device that enhances gait patterns | |
| Gait mechanics | 4. Patient will improve gait speed to >0.3m/s | 4. Patient will improve gait speed to >0.4 m/s improving functional status to limited community ambulator | (C) A RW was introduced to the patient, as mentioned previously, for over ground locomotor training. The RW proved to be the preferential assisted device for the patient during ambulation. Walking with a RW was incorporated into the HEP under the aerobic training (progressively more intense walking over-ground with RW and contact guarding from home-health professional). The variable that should be progressed with this goal in mind is walking speed. As long as the patient can tolerate with proper form and control, the speed of walking should be progressed as tolerated. The patient was instructed on how to time himself set distances to ensure he is challenging his pace. (C) Walking with WSTT (as described above) was also utilized to improve walking speed. (See Interventions that Changed). |
| Postural Control during ambulation | The patient will increase postural control during ambulation, which is assessed with the number of stumbles the patient displays during the 6MWT  
- Decrease to 12 stumbles during 6 MWT | The patient will increase postural control during ambulation, which is assessed with the number of stumbles the patient displays during the 6MWT  
- Decrease to 5 stumbles during 6 MWT | (C) The therapeutic interventions used during balance training, aerobic training, strength training, ROM exercises and cueing during gait training were used to address this goal.  
(C) Also, incorporating a RW allowed for immediate static and dynamic improvements during ambulation. |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Impaired Functional Mobility</td>
<td>Patient will demonstrate increased functional mobility with a decreased performance time on the TUG; score less than 43.6s using a FWW and contact-guarding</td>
<td>Patient will demonstrate increased functional mobility with a decrease in performance time of &gt;2.9s on the TUG</td>
<td>Training with RW, WSTT and over ground locomotor training are being utilized to help achieve this goal. In addition, the LE strengthening exercises will also help the patient achieve this goal by strengthening the transfer component of this skill (See LE strength interventions above).</td>
</tr>
<tr>
<td><strong>PARTICIPATION RESTRICTIONS</strong></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
| Unable to return to work | Obtain referral for occupational therapist to improve independence with activities of daily living  
Educate caregivers on potential for depression. Obtain referral for mental health. | Follow-up that patient has utilized referrals. | (C&E) Due to severe impairments patient will not likely resume work as a political consultant. However, the patient desired to resume work activities, so increasing the patient’s social and familial responsibilities may help with his depression.  
(E) Family was encouraged to find activities that patient could perform regularly to increase his confidence and help him reestablish a meaningful role or a sense of contribution to the family.  
(C) Referrals to the appropriate healthcare professionals were made for occupational and mental health. |
| Dependent in B/IADL | The patient will be less dependent in B/IADLs as per patient report. | The patient will show changes in the SIS:  
- Strength = 9.2  
- ADL/IADL = 5.9  
- Mobility = 4.5 | (C&E) It is unrealistic to expect the patient to become independent in all B/IADL, but through the utilization of proper motor patterns in |
activities like transfers and grooming, it is likely that the patient could gain some independence. These skills are expected to improve with OT and through previously mentioned therapeutic interventions.

<table>
<thead>
<tr>
<th>Dependent for Community Mobility</th>
<th>Patient will be introduced to RW</th>
<th>Patient will demonstrate independent ambulation with RW on flat surface for 100 feet.</th>
</tr>
</thead>
</table>

ROM= Range of Motion
EROM= End Range of Motion
HE= Hip Extension
KE= Knee Extension
DF= Dorsiflexion
LE= lower extremity
HEP= Home Exercise Program
adb= Abduction
add= Adduction
PF= Plantar-flexion
FWW= Front-wheeled walker
RW= Reverse walker
6MWT=6 minute walk test
10MWT= 10 meter walk test
BWSTT= body-weight supported treadmill training
S= Second(s)
L= Left
R= Right
TUG= Timed Up-and-Go
ADL= Activity of Daily Living
IADL= Instrumental Activity of Daily Living
SIS= Stroke Impact Scale
mCTSIB= Modified Clinical Test of Sensory Interaction on Balance

(C) All of the previously stated interventions will be working to help the patient achieve this goal in addition to gait training with the RW.
Prognostic Considerations

Acutely, major prognostic factors after a hemorrhagic stroke pertain to the following: level of consciousness at the time of admission to acute facility, hypertension, size of hematoma, hemispheric localization, and vascular territory. Based on the patient’s history, he was in a state of reduced consciousness when he arrived at the hospital initially, which has poor prognostic implications (likely attributed to hydrocephalus and brainstem compression). Furthermore, functional impairments are more profound in patients with hemorrhagic events versus infarction, but patients have shown substantial improvements in the Functional Independence Measure score after rehabilitation from these events. There is a lack of research supporting prognostic indicators for a patient’s projected functional mobility and ambulatory status several years post cerebellar stroke. However, enough is known about the patient’s history, current health status, and environmental factors to identify prognostic indicators.

The patient’s positive prognostic indicators stem from the general good health of the subject. He has normal cholesterol levels, blood pressure, a high level of education, a comfortable socioeconomic status (no limitations to healthcare treatment), no adverse behavioral factors (he does not drink, smoke, and he tries to get activity daily), a high level of compliance to previous therapy regimens, cognitive functioning intact, and an extremely supportive family who are happy to aid in his care as much as possible.

Negative prognostic indicators (in addition to those mentioned previously) include the amount of time since the stroke (4 years) and the severity of the ataxia that
the patient exhibits. Due to the severity of the ataxia in the lower extremities, recovery of ambulation without an assistive device was not expected; however, with the RW the patient required less assistance during ambulation. The patient is not likely to regain the ability to perform ADLs independently due to the presence of ataxia and subsequent lack of postural control. The patient is likely to regain the ability to ambulate short distances with a RW without assistance.

The patient had made modifications to his home, and had a willing caretaker (both physically and financially in his spouse). The patient was discharged to his caregiver in his current living situation with a HEP.

**Plan of Care- Interventions**

See Table 3.

**Overall Approach**

The guiding treatment philosophy utilized during this course of PT focused on task-specific training. There is mounting evidence in the literature as to the value of this type of neuromotor intervention when it is used for neurological rehabilitation. The basic principles of this philosophy include practicing context-specific motor tasks and receiving some form of feedback. When using this as a framework for rehabilitation, the focus is on improvement of performance in functional tasks through goal-directed practice and repetition. The improvements observed in aerobic capacity were due to the overload principle, affecting aerobic energy pathways, and affecting cardiovascular and respiratory functioning. By pushing the patient a little further than his previous maximal
distance, therapy was able to increase the patient’s muscular and cardiorespiratory endurance.\textsuperscript{38}

The patient’s primary concern in this case study was to improve his ability to walk, and as such, task specific training with the overload principle supplied the foundation to achieve his locomotor-related goals. All interventions for locomotor training included high repetition, context specific training and were goal-directed, usually in the form of walking to a particular target. The patient responded very well to this approach. To enhance one’s functional ability by practicing said functional task is intuitive, and therefore the patient needed no education as to why he was performing walking as a therapeutic exercise. He was very motivated by the approach and enjoyed the variations in practice conditions (body-weight supported treadmill training (BWSTT), over-ground with FWW and RW).\textsuperscript{39}

Overall, the patient received instruction and repeated practice in therapeutic interventions including balance exercises, endurance training, gait training with a new assistive device, gait training with BWSTT, a home evaluation, and a home exercise program. The patient received several therapeutic interventions in the form of manual therapy with joint mobilizations to restore ROM, therapeutic exercises to restore strength, neuromuscular/proprioceptive training to improve balance, and task-specific training to restore postural control and gait functioning.

\textit{Interventions}
Interventions have been outlined in detail in Table 3. In addition the therapeutic interventions the patient received in pro bono clinic, he also was instructed in a home exercise program (HEP), which complimented all therapeutic interventions the patient received within the clinic. All individuals involved with the subject’s care (his spouse, daughter, hired caretaker, and home therapists) were instructed on how to perform the HEP so they may assist the patient with proper execution of the exercises and provide the required safety measures. The ROM exercises were performed twice daily, and the endurance and the balance exercises were performed once daily. Strengthening exercises were performed three times a week with rest days between exercises. More information regarding the home exercises can be found in Table 3 as well.

**PICO question**

For an elderly patient with chronic cerebellar stroke (P), is BWSTT (I) more beneficial than conventional, nonspecific forms of therapy (C) for improving gait parameters and independence during ambulation (O)?

Three articles were utilized to address this PICO question. The first article was a randomized control trial (level of evidence:1b; Pedro score = 7/10).\(^{40}\) The authors investigated if there was a superior effect for patients with chronic stroke who received conventional physiotherapy in addition to BWSTT over individuals who only received BWSTT. All subjects received 9 weeks of standard care before starting three weeks of specific interventions. The authors concluded that the three-week combination of BWSTT with physiotherapy effected a larger improvement at the end of the study in
functional ambulation ability. All participants in this group improved. The differences between groups in gait speed immediately after the study were not significant. Follow-up measures 4 months after discharge from the rehabilitation unit showed the functional ambulation differences between groups were not preserved. Based on this information, therapists can expect to impact a significant change in the short term by using both BWSTT and conventional physical therapy.

The second study was a multicenter, single-blind randomized controlled trial, stratified by walking impairment level at two months after onset of stroke (level of evidence: 1b; Pedro Score: 7/10). The authors compared two conceptually different interventions. From two to six months post stroke, patients were divided into three groups where group one received only usual care, group two received usual care plus 36 therapy sessions where the patient was able to engage in BWSTT and over-ground training, and group three received usual care plus 36 therapy sessions that focused on impairment-based strength and balance exercises at home. The authors were able to conclude that progressive physical therapy that utilized over-ground, treadmill training or strength and balance training performed was superior to usual care in improving walking. These findings were true regardless of the severity of initial impairment. The treadmill-training group did show only slightly better improvements over the general strength and balance exercise group. This study is very applicable to my PICO question, showing that patients should improve with either intervention strategy. However, my patient has had more time lapse since his stroke than the individuals used in this study.
The third article was a Cochrane Review (Level of Evidence: 1a; Pedro scores of 15 RCTs ranged from 4/10 to 8/10). The study investigated the use of treadmill training with and without body weight support post stroke to address limitations with walking. Several studies within the systematic review showed no difference in treatment approaches in terms of walking independently. Patients who utilized BWSTT showed significant improvements in walking velocity and walking endurance.

The articles previously reviewed are the best the literature has to offer in terms of task specific locomotor training for patients with chronic ataxia secondary to stroke. BWSTT is a relevant and preferential way to train a patient who is dependent on assistance during gait. BWSTT will allow the patient to have task specific training without the fear of falling. Patients will also be able to accrue a higher volume and velocity during a therapy session than he receives with his over-ground training with a walker. Additionally, it is a less stressful intervention for the therapist because less assistance to maintain postural control is required.

**Interventions that Changed**

One of the primary interventions I expected to use with this patient was BWSTT. However, after the second session of utilizing this resource, the patient expressed his discomfort with the intervention. He expressed that the harness was not comfortable, and he was not able to successfully demonstrate proper utilization of either the FWW or the RW on the treadmill. When the LiteGait was used over ground, the patient still expressed that the harness was not comfortable, which could easily be observed with further
degradation of mechanics during gait training. Although the intervention is supported in the literature and it greatly enhanced patient safety, body-weight support locomotor training on the treadmill and over ground was found to be too cumbersome and uncomfortable for this patient and was abandoned after the second trial. It was replaced with over-ground locomotor training using a RW, which proved to be preferential for the patient.

The patient had sensitivity to positional changes that resulted in increased levels of dizziness that lasted up to several minutes. Standing up after lying down, or activities requiring a lot of head movement often resulted in increases in dizziness. Habituation exercises were implemented to desensitize the vestibular system and reduce his symptoms (vestibular ocular reflex exercises); however, the patient was not tolerating the habituation training well. The exercises interfered with the patient’s postural control during gait activities so therapeutic activities targeted toward habituating the vestibular system were abandoned. The patient’s response was noted, and recommendations were made to his wife to seek a referral to address the patient’s dizziness.

Also, the balance master was utilized to increase the patient’s cone of stability, balance, and reactive control. The patient performed 15 minutes of balance training on the balance master, utilizing weight-shifting activities in all directions in addition to challenging his reactive control. This activity was also discontinued after two sessions due to prolonged increases in dizziness after completion. This may be attributable to several variables: the close proximity of the computer screen, the ocular control required
to follow an on-screen target, or just the visual demand required. However, the patient experienced increased dizziness after 5 minutes of training with the device. The patient would request to sit down and would need 5 minutes before dizziness would return to baseline. After two trial sessions training on the balance master was discontinued as a therapeutic intervention.

**Indirect Interventions**

Indirect interventions utilized with this patient consisted mostly of patient education and family training, which has been previously discussed in detail. In addition to education and training, structural modifications were suggested for the patient’s home to increase function in his home environment. The family requested training for the patient to use the toilet in the restroom as opposed to a portable commode in the bedroom. They were instructed to attach a raised toilet seat to the existing toilet to decrease the difficulty experienced by the patient when transferring between WC and toilet. Furthermore, the medical equipment in his bedroom was rearranged to allow for easier transfers. Lastly, the family was encouraged to widen doorframes within the home to allow for enhanced maneuverability for the patient when in his WC.

The patient also received referral/recommendations to obtain services from other healthcare professionals, which have been explained in detail previously. He also received training with a RW. This assistive device proved to be beneficial for the patient, and a recommendation was made for the patient to obtain a RW. A letter of medical
necessity was written for the patient in an attempt to obtain coverage for the reverse walker from Medicare.

Lastly, the patient voiced an interest in a recumbent tricycle; it may be advantageous to schedule a meeting with a recreational therapist to see if a recumbent bike may be a safe and feasible option for him. His wife rides a bike, so this may be a way for the patient to increase his activity level while recreating with his wife.
## Chapter 6

### Outcomes

Table 5

<table>
<thead>
<tr>
<th>OUTCOMES</th>
<th>BODY FUNCTION OR STRUCTURE IMPAIRMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome</strong></td>
<td><strong>Initial</strong></td>
</tr>
<tr>
<td><strong>ROM</strong></td>
<td>Right Hip Ext:-5° DF:0-5°</td>
</tr>
<tr>
<td><strong>Balance mCTSIB</strong></td>
<td>a) 30 seconds (3 inches between medial malleoli) b) 18 seconds (3 inches between medial malleoli) c) unable to perform d) unable to perform</td>
</tr>
<tr>
<td>Tandem stance (s)</td>
<td>Stance width: 3 inches</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Eyes open: 10 s</td>
<td>Eyes open: 30 s</td>
</tr>
<tr>
<td>Eyes closed: 3 s</td>
<td>Eyes closed: 15 s</td>
</tr>
</tbody>
</table>

### ACTIVITY LIMITATIONS

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Initial</th>
<th>Follow-up (12weeks)</th>
<th>Change</th>
<th>Goal Met (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRT</td>
<td>8 cm excursion</td>
<td>11 cm excursion</td>
<td>+3 cm</td>
<td>Y (&gt;10cm)</td>
</tr>
<tr>
<td>10MWT</td>
<td>0.3 m/s</td>
<td>0.5m/s</td>
<td>+0.2m/s increase</td>
<td>Y (&gt;0.4 m/s)</td>
</tr>
<tr>
<td>6MWT (distance)</td>
<td>240 ft. FWW</td>
<td>448 ft.</td>
<td>+208 ft.</td>
<td>Y</td>
</tr>
<tr>
<td>6MWT (number of stumbles)</td>
<td>18 with a FWW with sliders</td>
<td>15 FWW</td>
<td>-3</td>
<td>Y</td>
</tr>
<tr>
<td>TUG</td>
<td>43.6 s FWW and contact guard</td>
<td>38.2 s with FWW and contact guard</td>
<td>-5.4 s</td>
<td>Y</td>
</tr>
</tbody>
</table>

### PARTICIPATION RESTRICTIONS

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Initial</th>
<th>Follow-up</th>
<th>Change</th>
<th>Goal Met (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIS</td>
<td>SCORE</td>
<td>SCORE</td>
<td>+10</td>
<td>Y (minu s ADL/I ADL)</td>
</tr>
<tr>
<td>DOMAINE</td>
<td>Strength:</td>
<td>55</td>
<td>65</td>
<td>+10</td>
</tr>
<tr>
<td>Memory:</td>
<td>70</td>
<td>70</td>
<td>+0</td>
<td></td>
</tr>
<tr>
<td>Emotion:</td>
<td>70</td>
<td>70</td>
<td>+0</td>
<td></td>
</tr>
<tr>
<td>Communication:</td>
<td>40</td>
<td>40</td>
<td>+5</td>
<td></td>
</tr>
<tr>
<td>ADL/IADL:</td>
<td>55</td>
<td>55</td>
<td>+5</td>
<td></td>
</tr>
<tr>
<td>Mobility:</td>
<td>45</td>
<td>50</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hand function:</td>
<td>50</td>
<td>50</td>
<td>+5</td>
<td></td>
</tr>
<tr>
<td>Social participation:</td>
<td>35</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ROM= Range of Motion  
Y=yes  
N=no  
Ext= extension  
DF= dorsiflexion  
Abd= abduction  
Add= adduction  
PF= plantarflexion  
mCTSIB=modified clinical test of sensory integration and balance
s = second(s)
FRT = functional reach test
cm = centimeter
10MWT = 10 meter walk test
m = meter(s)
6MWT = 6 minute walk test
ft. = feet
FWW = front-wheeled walker
RW = reverse walker
TUG = timed up-and-go
SIS = stroke impact scale
ADL = activities of daily living
IADL = instrumental activities of daily living
Discharge Statement

The patient attended outpatient physical therapy for treatment of a chronic hemorrhagic stroke of the cerebellum once a week for 12 weeks between October and November 2013 followed by four visits (once a month) from January to April, 2014. The patient received ROM and strengthening exercises, balance exercises, endurance training, gait training, instruction with a new assistive device, a home evaluation, and a home exercise program. He was limited in B/IADLs due to impaired postural control, and impaired aerobic endurance. These impairments resulted in the patient requiring assistance during ambulation. Over the course of therapy, the patient achieved ROM (aside from left ankle DF), strength, balance, functional mobility and walking goals. Most importantly, the patient reported that he noticed improvements in several domains of the SIS. Although he did not obtain statistically significant changes in all parameters, the patient reported that his improvements with walking and postural control gave him confidence that were spreading into other areas of his life.

The patient was also able to perform all the exercises from his HEP independently but was still instructed to do most of them under the supervision of one of his many care providers. Based on the improvements in gait parameters and the patient’s welcomed reception of a new assistive device, he was given a reverse walker on loan until the patient can obtain a reverse walker of his own.

Discharge G-Codes:

- Mobility: Walking & Moving Around current: G8980
- Modifier: CL 60-79% impaired
  - Patient walked 158m with RW at last visit

- Changing & Maintaining Body Position: G8983
  - Modifier: CJ 20-39% impaired
  - Patient had a functional reach of 11cm at last visit
Chapter 7

Discussion

All of the patient’s goals were met except for one impairment level goal and one component of the participation level goal. This can be attributed to the patient’s motivation to improve postural control and ultimately walk further with increasing independence. The patient’s static balance as measured by the mCTSIB did not improve a significant amount. I believe this can be attributed to the patient’s impairment of ataxia, which is not likely to diminish in the short amount of time the patient was treated in mock clinic. Physical therapy cannot decrease the lesion in the cerebellum resulting in the ataxia, but with task-specific training and potential neural plasticity PT can impart an improvement in function. The plan of care focused on improving the patient’s impairments outside of ataxia, which included ROM, balance, and endurance deficits. Repetition, task specific training, and the overload principle were utilized as foundations of therapeutic interventions. Modifications in adaptive equipment and recommendations for home modifications were incorporated into the plan of care. The patient’s ambulation with this assistive device showed improvement in number of stumbles, speed, and distance when compared to ambulation with the FWW. This improvement can be attributed to the improvements in underlying impairments and the motor learning that occurred through the repetitive use of the RW.

One of the most significant improvements the patient made was related to changes in postural control. The patient’s safety improved as was measured by his post-test
balance measures. In particular, performance on his FRT showed that he surpassed the cutoff for being at risk of falls. Overall, this course of PT was a success for this patient because he reported he had made great improvements, particularly in his balance and ability to ambulate.

If I were to treat a similar patient in the future, I would treat him/her with similar interventions, but provide as much of the therapy in their home environment as possible. Treating the patient in his/her own home would allow for environment-specific training to maximize his level of independence. I would provide a plan of care that is more efficient and utilize fewer outcome measures. I would perform a thorough home evaluation and place more emphasis on a HEP. Also, since this patient had mild proprioceptive deficits, I might add Frenkel exercises to the plan of care to compensate for the motor deficits of the cerebellum, but there is not a lot of research supporting the success of these exercises.
References


15. Steiner WA, Ryser L, Huber E, Uebelhart D, Aeschlimann A, Stucki G. Use of
the ICF model as a clinical problem-solving tool in physical therapy and

16. Blum L, Korner-Bitensky N. Usefulness of the Berg Balance Scale in stroke

17. Weyer A, Abele M, Schmitz-Hübsch T, Schoch B, Frings M, Timmann D,
Klockgether T. Reliability and validity of the scale for the assessment and rating

18. Kim BR, Lim JH, Lee SA, Park S, Koh SE, Lee IS, Jung H, Lee J. Usefulness of
the Scale for the Assessment and Rating of Ataxia (SARA) in Ataxic Stroke

Establishing a diagnosis of benign paroxysmal positional vertigo through the dix­
May;14:201-4.

20. Bhattacharyya N et al; American Academy of Otolaryngology-Head and Neck
Surgery Foundation. Clinical practice guideline: benign paroxysmal positional


