OUTPATIENT PHYSICAL THERAPY FOR A PATIENT WITH MODERATE DISABILITY DUE TO MULTIPLE SCLEROSIS

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
Meghan Fuccella

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Department of Physical Therapy
Abstract

of

OUTPATIENT PHYSICAL THERAPY FOR A PATIENT WITH MODERATE DISABILITY DUE TO MULTIPLE SCLEROSIS

by

Meghan Fuccella

A 64 year-old female with 21 year history of multiple sclerosis was seen for physical therapy treatment for eight sessions from 2/11/15 to 4/8/15 at the California State University, Sacramento neurological pro bono clinic. Treatment was provided by a student physical therapist under the supervision of a licensed physical therapist.

This patient was examined over the course of the first 2 sessions using the Modified Fatigue Impact Scale, Modified Clinical Test of Sensory Integration in Balance, Six Minute Walk Test and Multiple Sclerosis Quality of Life questionnaire, visual observation, sensory, coordination and proprioception testing, Modified Ashworth Scale and Activities-Specific Balance Confidence scale. These measures were used to determine an appropriate plan of care, including goals to improve static and dynamic balance, walking endurance, range of motion, quality of life and to decrease the impact of fatigue. Interventions for this patient included overground interval gait training, balance activities, stretching program and patient education.
After the course of treatment, the patient demonstrated decreased impact of fatigue, increased walking endurance and improved static balance. This patient was discharged to her home with a home exercise program.

_____________________________________, Committee Chair
Bryan Coleman-Salgado, PT, DPT, MS, CWS

________________________
Date
ACKNOWLEDGEMENTS

I acknowledge California State University, Sacramento for allowing me to learn about and treat patients with neurological disorders as well as for recruitment of this patient to the pro bono clinic.
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Chapter 1

**General Background**

Multiple sclerosis (MS) is a disease of unknown etiology that is characterized by focal demyelination of one or more areas of the central nervous system (CNS).\(^1,2\) Multiple sclerosis is newly diagnosed in almost 8 per 100,000 persons each year, but this number will vary according to one’s geographic location by latitude.\(^3\) Multiple sclerosis is more prevalent according to geographic region but the evidence is unclear on the specific distribution. The traditional theory of increased prevalence with increasing distance from the equator has been questioned recently and requires additional research on the matter.\(^4\) This disease predominately occurs in females anywhere from 2-3 times more often than males and is more commonly diagnosed at the third decade of life.\(^3,4\) The average age for those living with MS globally has increased to 55-59 years old from a previous average age of 45-49 in 1991.\(^3\) This is attributed to an increase in the quality of medical care for patients with MS and therefore longer life spans.\(^3,4\)

Advanced imaging techniques and diagnostic tests continue to reveal the varied pathology that is classified as multiple sclerosis. MS remains classified as an inflammatory disease that affects the central nervous system via demyelination and subsequent scarring which forms sclerotic plaques.\(^1,2\) The lesions to the nerve tissue are thought to cause the impairments. The reason for the abnormal inflammatory
response is not understood but is considered an autoimmune response of varied intensity acting on white and grey matter of the CNS.\textsuperscript{2} The variation in amount and location of tissue affected leads to the large spectrum of symptoms and impairments demonstrated by patients with MS.\textsuperscript{1,2} Imaging shows evidence that remyelination occurs but the regenerated tissue is the most susceptible to additional insult or attack that results in subsequent demyelination and scarring of the “recovered” tissue.\textsuperscript{2} Strong support exists for prior history of Epstein-Barr virus, infectious mononucleosis and smoking as risk factors for acquiring the disease.\textsuperscript{5}

Multiple sclerosis has traditionally been a difficult diagnosis to make due to the variety and inconsistent nature of the disease. Diagnostic tests for MS include cerebrospinal fluid (CSF) testing and magnetic resonance imaging (MRI), but the most valuable diagnostic criteria remains one of exclusion with a characteristic cluster of symptoms affecting multiple systems.\textsuperscript{6} Patients with MS are generally categorized into one of five disease courses: Benign, Relapsing-Remitting (RRMS), Secondary-Progressive (SPMS), Primary-Progressive (PPMS), Progressive-Relapsing (PRMS). Those with the benign course will remain stable throughout their life with no change in functional ability. RRMS indicates exacerbations or relapses followed by complete recovery to prior function. Those with SPMS will experience similar episodes of relapse with only partial recovery to prior function and generally experience a decline in function. Individuals with MS who decline steadily without distinct exacerbation
are considered to be PPMS. Finally, patients with PRMS experience a continual worsening with possible, brief periods of partial recovery.\(^7\)

Once diagnosed, patients with MS may be classified based on the extent of disability using the Expanded Disability and Severity Scale (EDSS).\(^8\) The EDSS describes a patient’s severity in terms of functional ability, using a scale of 0-10 with 0 indicating no neurological signs or symptoms and 10 indicating death due to MS.\(^8\) The EDSS scale can further categorize patients with MS by severity of disability. An EDSS score of 0-3.5 can be categorized as little to no disability; 4-5.5, mild disability; 6-7.5, moderate disability and 8-9.5, severe disability.\(^9\)
Chapter 2

Case Background Data

Examination – History

The patient was a 63 year old female who was diagnosed with multiple sclerosis 21 years ago. She presented with chief complaints of fatigue, decreased stamina and poor posture.

The patient’s first symptom occurred in 1985 and was described as an electric pain down her neck and back (Lhermitte’s sign\(^1\)). Following this event the patient reported sleeping for 2 days and her symptoms resolved. She received a computerized tomography (CT) scan which was determined to be negative for CVA and brain tumor. Several years later the patient experienced a sudden loss of hearing in her right ear which resolved with prednisone prescribed by her doctor. Six months later the patient was found to have optic neuritis and was subsequently diagnosed with MS in 1994. At the time of diagnosis the patient was ambulating without any assistive device and would fall occasionally. By 1998 the patient was using a 4WW and manual wheelchair. The patient reported that her worst exacerbation occurred in the year 2000 and that she was unable to ambulate or stand due to weakness and lower extremity numbness. She switched to using a powered scooter for all mobility shortly after this episode and reported becoming very sedentary.
In November of 2014, the patient began a comprehensive program dedicated to persons with MS, the MS Achievement Program. This program’s duration and frequency was 5 hours, 1 day each week and included supervised exercise, meditation and cognitive training with supervision from medical doctors, physical therapists and occupational therapists. After 3 months of participation in the MS achievement program the patient reported she was able to ambulate with her 4WW from the parking lot to restaurants and stores. The patient reported she was still utilizing her powered scooter for longer distances such as shopping at the mall and going to the casino. The patient reported an increase in mood since beginning that program. Given her recent change in function, the patient reported her doctor was unsure of her classification at her most recent visit. According to the classification criteria described above, I found the patient would be classified in the RRMS group.

The patient was previously treated by student physical therapists in previous years of pro bono clinic and continued to follow-up with her primary care physician to monitor and address her medication needs. The patient was self-referred to the pro bono clinic. Her chief complaint at the time of this evaluation was her inability to walk long distances. She expressed desire to train to participate in the MS Walk on April 19th (9 weeks away) and to increase her stamina. She wished to gain confidence with walking on uneven surfaces.
This patient lived with her husband in a single-story home in a suburban area with a slanted driveway. The home evaluation revealed appropriate modifications made for access to bathroom and bedrooms with 4WW and appropriate arrangement of kitchen items for safe use. Her adult children lived several hours away but did visit a few times a year. They have four grandchildren in total, all of grade school age. This patient worked as a full time office manager but retired in 1994 due to complaints of excessive fatigue. The patient reported attending a weekly book club, MS support group and MS achievement program.

**Systems Review**

A systems review was performed and this patient demonstrated impaired cardiopulmonary system as evidenced by high blood pressure and decreased heart rate response during exercise. The patient’s musculoskeletal and neuromuscular systems were impaired showing decreased coordination and spasticity, as shown by the heel to shin test, a positive Modified Ashworth Scale test and based on her medication history positive for anti-spasticity medications. The integumentary system was found to be impaired due to medication use for skin rash. However, normal pliability, no abnormal scars, and no open wounds visible or upon questioning the patient were noted. This patient’s cognition and affect were impaired based on patient reported anxiety and depression currently being managed with medication and support group attendance. The patient’s learning and language
were not impaired based on observation of normal language, correct 3-item recall and ability to follow 3-step commands.

**Examination - Medications**

Table 1

<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>DOSAGE</th>
<th>REASON</th>
<th>SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lorsartan</td>
<td>Dosage unknown, daily (oral)</td>
<td>High Blood Pressure</td>
<td>Pain in the extremities, gastrointestinal (GI) distress, muscle weakness of cramps, decreased sensitivity to touch, difficulty breathing or swallowing, swelling of face or throat, hoarseness, chest pain</td>
</tr>
<tr>
<td>Duloxetine</td>
<td>30 mg/day (oral)</td>
<td>Depression and generalized anxiety</td>
<td>GI distress, dizziness, headache, fatigue, weakness, drowsiness, muscle pain or cramps, uncontrollable shaking of a part of the body</td>
</tr>
<tr>
<td>Levothyroxine</td>
<td>112 mg/day (oral)</td>
<td>Hypothyroidism</td>
<td>GI distress, weight loss, tremor, headache, irritability, nervousness, insomnia, fever, heat sensitivity</td>
</tr>
<tr>
<td>Betamethasone</td>
<td>0.1% concentration, PRN (topical)</td>
<td>Various skin conditions including dryness and redness</td>
<td>Severe skin rash, difficulty breathing or swallowing, wheezing</td>
</tr>
<tr>
<td>Modafinil</td>
<td>200 mg/day (oral)</td>
<td>Fatigue</td>
<td>Headache, dizziness, insomnia, drowsiness, GI distress, tight muscles or difficulty moving, back pain, confusion, uncontrollable shaking of a part of the body</td>
</tr>
<tr>
<td>Gabapentin</td>
<td>300 mg/day (oral)</td>
<td>Spasticity</td>
<td>Drowsiness, tiredness, weakness, dizziness, headache, uncontrollable shaking of a part of body, double or blurred vision, anxiety, GI distress, swelling of the extremities, back or joint pain, flu-like symptoms</td>
</tr>
<tr>
<td>Hydrocodone</td>
<td>10 mg, PRN (oral)</td>
<td>Pain relief</td>
<td>GI distress, tiredness, dizziness, headache, back pain, tightening of muscles</td>
</tr>
<tr>
<td>Solifenacin</td>
<td>5 mg/day (oral)</td>
<td>Overactive bladder</td>
<td>GI distress, blurred vision, extreme tiredness</td>
</tr>
<tr>
<td>Drug</td>
<td>Dosage</td>
<td>Indication</td>
<td>Side Effects</td>
</tr>
<tr>
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<td>-------------------------</td>
<td>---------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Interferon Beta-1b</td>
<td>0.3 mg/frequency not reported (subcutaneous injection)</td>
<td>Relapsing Remitting Multiple Sclerosis (MS) treatment</td>
<td>GI distress, weight gain or loss, feeling cold or hot much of the time, dizziness, incontinence, joint or muscle weakness or pain, leg cramps</td>
</tr>
<tr>
<td>Simvastatin</td>
<td>20 mg/day (oral)</td>
<td>High cholesterol</td>
<td>GI distress, memory loss, confusion, headache, myalgia</td>
</tr>
<tr>
<td>Acetaminophen (Tylenol)</td>
<td>300 mg, PRN (oral)</td>
<td>Pain relief</td>
<td>Severe skin reaction, swelling of eyes/lips/face/tongue/throat/hands/feet/ankles, difficulty breathing or swallowing, GI distress</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>5000 mg/day (oral)</td>
<td>Complementary and Alternative Medicine (CAM) treatment of MS</td>
<td>Calcium deposits, confusion and disorientation, kidney damage, GI distress</td>
</tr>
<tr>
<td>Vitamin B complex</td>
<td>Patient unsure of dosage, daily (oral)</td>
<td>Fatigue</td>
<td>GI distress</td>
</tr>
<tr>
<td>L-Lysine</td>
<td>Patient unsure of dosage, daily (oral)</td>
<td>CAM treatment of MS</td>
<td>GI distress</td>
</tr>
</tbody>
</table>

mg=milligram; GI=gastrointestinal, PRN= as needed
Chapter 3

Examination – Tests and Measures

This patient’s deficits were classified according to the International Classification of Functioning, Disability and Health (ICF) model.\textsuperscript{11} Diagnostic tests utilized to identify body structure and function impairments included the Modified Clinical Test of Sensory Integration in Balance (mCTSIB), light touch sensation test, up/down test, Modified Ashworth Scale (MAS) and observation of gait. Remaining body structure and function impairments were assessed with visual estimate of lower extremity passive range of motion (PROM) and coordination test. Several tests were used as outcome measures: Limitations at the activity level were identified using tests of balance, balance confidence, walking endurance, including Dynamic Gait Index (DGI), Activities-Specific Balance Confidence scale (ABC scale) and Six Minute Walk Test (6MWT) respectively. In addition, the DGI and ABC scale are both tests used to prognosticate for fall risk. Participation restrictions were assessed using the Modified Fatigue Impact Scale (MFIS), the Multiple Sclerosis Quality of Life-54 (MSQOL-54) questionnaire and patient report about her ability to participate in MS Walk.

Vestibular, vision and somatosensory functioning in balance were assessed using the mCTSIB. The mCTSIB consists of timed static balance tested under 4 different conditions: Eyes open on firm surface, eyes closed on firm surface, eyes
open on a foam surface and eyes closed on a foam surface. The patient was timed for up to 30 seconds, for 3 trials of each condition. Psychometric data for the MS population does not exist at this time but this test format has shown moderate test-retest reliability (r=0.75) in community dwelling older adults.\textsuperscript{12} Balance system organization and normative data for older adults suggest that decreased performance during vision-eliminated trials indicates vestibular impairment.\textsuperscript{13} Screening for somatosensory impairment with this patient was not possible due to patient anxiety. One trial of the foam condition was recorded but the patient chose to end test due to anxiety. To supplement this incomplete data, lower extremity light touch sensation and lower extremity joint proprioception were assessed separately to gain some insight into her somatosensory function.

Sensation was screened by light touch dermatomal testing. With the patient seated and eyes closed, a single light touch was applied to the patient’s skin at each dermatomal section from L2 to S1, with the fingertip. The patient was asked to determine if any differences were felt between the two limbs. If the patient reported a difference in sensation, the limb reported as diminished sensation was considered impaired.

Passive range of motion (PROM) was grossly estimated for hip extension and ankle dorsiflexion. Hip extension was assessed in sidelying and ankle dorsiflexion in sitting. Limitation in PROM of the hip or ankle impairs gait\textsuperscript{14}. 
Proprioception of the lower extremities were screened using the up/down test at the ankle, knee and hip, bilaterally. With the patient’s eyes closed, the lower leg was supported and each joint was moved up or down for a total of 10 repetitions at each joint. Correct response of movement direction indicated intact proprioception. Any inability to detect the movement is indicative of impaired proprioception.

Gait deviations were noted while observing patient ambulation with use of 4WW. Gait was assessed from anterior, posterior and side view. Specifically, Trendelenburg sign is indicative of motor control or weakness of the ipsilateral hip abductors or pain with weight bearing in that lower extremity. Genu recurvatum during gait indicates poor motor control of the extensor musculature of the lower extremity as well as increased laxity of the posterior knee capsule.

Coordination was assessed using the heel to shin test. The patient was seated and instructed to trace shin with opposite heel for 10 repetitions while maintaining contact with shin. Coordination was considered intact if the patient was able to maintain contact with the shin in a smooth and continuous path without error. If patient was unable to perform the test successfully, coordination impairment exists, specifically dysmetria. This is indicative of cerebellar impairment.14

Spasticity was assessed using the Modified Ashworth Scale (MAS). This scale grades the resistance to slow and fast movements about a single joint on a
scale of 0-4. A score of 0 indicates no resistance with high velocity movement and 4 indicates rigidity when high velocity movement is applied. Psychometric data for this outcome measure is unavailable for patients with multiple sclerosis and evidence for this measure is inconsistent or weak.\textsuperscript{15} The presence of spasticity was confirmed by medication history.

Functional balance was quantified with the Dynamic Gait Index (DGI) and considered an activity level impairment. The DGI assesses dynamic balance during gait, with or without an assistive device. Each of eight tasks are scored on a 0-3 scale for a total possible score of 24 with the lower scores indicating decreased dynamic balance. The DGI has demonstrated excellent intrarater reliability (0.98-0.99) and strong test-retest reliability (0.85) in the MS population.\textsuperscript{16,17} The minimal detectable change (MDC) for the DGI in patients with MS is 5.54, based on the respective intrarater standard error of measure (SEM).\textsuperscript{18} No minimal clinically important difference (MCID) has been established for patients with MS to date, but in community dwelling older adults the MCID is less than the MDC in patients with MS and therefore not applicable.\textsuperscript{19} The cut-off score to determine increased fall risk for people with MS is a score of 19 points or less.\textsuperscript{20} The negative likelihood ratio for a score on the DGI higher than 19 was found to have a small (0.26) increase in the likelihood that the person would not fall.\textsuperscript{20}
Balance confidence during functional activity was measured with the ABC scale; a 16-item questionnaire. The score is reported as a percentage, with higher percentages indicative of increased balance confidence. The ABC scale is able to discriminate between fallers and non-fallers.\textsuperscript{18,21,22} In the MS population the cut-off score to discriminate between fallers and non-fallers is greater than 40 percentage points.\textsuperscript{18} This was reported to have adequate sensitivity and specificity (65% and 77%, respectively) with a significance of p=0.001. Both positive and negative likelihood ratios (calculated to be 2.86 and 0.45 respectively), indicate a small shift in post-test probability when determining fall risk. No confidence intervals were reported. An MDC for patients with stroke was calculated to be 18.8%.\textsuperscript{23} The ABC scale was recommended by the MS-EDGE task force as an appropriate measure for assessing balance confidence in the outpatient setting for patients with MS and an EDSS up to 7.5.\textsuperscript{24}

The Six Minute Walk Test (6MWT) is an activity level measure that evaluates walking endurance by measuring the distance an individual walks within 6 minutes. The greater the distance walked, the greater the walking endurance of the individual. The 6MWT has been shown to be a reliable measure in persons with multiple sclerosis (ICC of 0.991).\textsuperscript{25} In patients with multiple sclerosis and moderate disability (EDSS 4.0-6.5) the minimally important change (MIC\textsubscript{95}) was found to be 9.87m but the smallest real change (SRC) for the group was 11.55m therefore, the
SRC was used to measure change. No confidence interval for the SRC was reported.

The Modified Fatigue Impact Scale (MFIS) is a valid and reliable measure of the impact of fatigue in patients with MS. Test-retest reliability has been measured for the total score and found to be adequate to good (ICC=0.76). The MFIS is a multidimensional 21 item questionnaire that measures the impact of fatigue on the patient’s life over the previous month. The statements are rated on a scale of 0-4 with the higher number indicating the statement is true more often. A higher total score indicates an increased impact of fatigue on the subject’s life. This measure is responsive and the smallest detectable change (SDC) was proven to be 16.2 set at 95% CI. A score of 38 pts or greater indicates that fatigue significantly impacts the respondent’s function. The MFIS is a measure at the participation level and is recommended for use with patients with MS with an EDSS of less than 7.5, by the MS-EDGE taskforce.

A self-report questionnaire, the Multiple Sclerosis Quality of Life (MSQOL-54), was used to measure quality of life for this patient where a score of 100% indicates the highest quality of life and 0%, the lowest. This 54 item questionnaire was analyzed by the two main subscales, physical health and mental health. This measure was shown to have moderate responsiveness for both the physical health and mental health subscales and poor to fair discrimination [standardized response
mean (SRM) = 0.57, 0.71 and AUC= 0.67, 0.70]. No MDC was determined for this measure. Community ambulation distances and participation in community events were based upon patient reported.
<table>
<thead>
<tr>
<th>Measurement Category</th>
<th>Test/Measure Used</th>
<th>Test/Measure Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual, Vestibular and Somatosensory function</td>
<td>Modified Clinical Test of Sensory Integration in Balance (mCTSIB)</td>
<td>Eyes Open, Firm Surface (EO Firm)= 25 seconds (s), 25s, 30s Eyes Closed, Firm Surface (EC Firm)= 14s, 17s, 17s Eyes Open, Foam Surface (EO Foam)=3s, N/A, N/A (pt refused to attempt again) Eyes Closed, Foam Surface (EC Foam)= N/A (pt refused to attempt)</td>
</tr>
<tr>
<td>Sensation</td>
<td>Light touch</td>
<td>Diminished sensation to light touch in dermatomes L5 and S1 on R.</td>
</tr>
<tr>
<td>LE Passive Range of Motion (PROM)</td>
<td>Gross visual estimate</td>
<td>Hip extension: Gross estimate lacking 10 degrees in sidelying B, very firm end feel B. DF (seated with knee flexed): Decreased B, Unable to move beyond neutral B, firm end feel B.</td>
</tr>
<tr>
<td>Motor control of lower extremity musculature</td>
<td>Gait observation</td>
<td>B genu recurvatum noted during loading response and stance phase 100% of time during ambulation with 4WW. B Trendelenburg sign noted during stance phase 100% of time during ambulation with 4WW.</td>
</tr>
<tr>
<td>Coordination</td>
<td>Heel on shin test</td>
<td>L= 7/10 contact with shin at 50% ROM R=0/10 (no contact with shin.</td>
</tr>
<tr>
<td>Measurement Category</td>
<td>Test/Measure Used</td>
<td>Test/Measure Results</td>
</tr>
<tr>
<td>-----------------------</td>
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<td>----------------------</td>
</tr>
</tbody>
</table>
| Spasticity            | Modified Ashworth Scale | Ankle DF: L=0/4, R=3/4  
Knee flexion/extension: B=0/4  
Hip flexion/extension: B=0/4 |
| **ACTIVITY LIMITATIONS** |
| **Measurement Category** | **Test/Measure Used** | **Test/Measure Results** |
| Balance               | Dynamic Gait Index (DGI) | 12/24 (<19 indicates fall risk)**
| Balance confidence    | Activities-Specific Balance Confidence Scale (ABC scale) | 55% (<40% indicates fall risk) |
| Walking endurance     | 6 min walk test (6MWT) | 116.4m  
Pre-test exertion (modified Borg scale): 3/10  
Pre-test SOB (modified Borg scale): 0/10  
Pre-test pulse: 68 bpm, rhythmic, weak  
Pre-test BP: 143/96 (measured with patient supplied wrist device)  
Post-test exertion (modified Borg scale): 5/10  
Post-test SOB (modified Borg scale): 2/10  
Post-test pulse: 79 bpm, rhythmic, weak  
Post-test BP: unable to measure due to lack of appropriate size manual cuff and wrist device malfunction |
| **PARTICIPATION RESTRICTIONS** |
| **Measurement Category** | **Test/Measure Used** | **Test/Measure Results** |
| Impact of fatigue on life activities | Modified Fatigue Impact Scale (MFIS) | 51/84 (>38 indicates significant impact of fatigue)**
| Quality of life        | Multiple Sclerosis Quality of Life-54 (MS-QOL-54) | Physical Health Composite = 49.42%  
Mental Health Composite = 80.11% |
<table>
<thead>
<tr>
<th>Community ambulation</th>
<th>Patient report</th>
<th>Patient used powered scooter for community outings such as grocery shopping and casino trips.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in MS Walk</td>
<td>Patient report</td>
<td>Patient reported she was unable to ambulate in MS Walk in years prior, only able to participate using powered scooter.</td>
</tr>
</tbody>
</table>

LE=lower extremity; L=left; R=right; PROM=passive range of motion; B=bilateral; DF=dorsiflexion; 4WW=four wheeled walker; PF=plantarflexion; m=meter; SOB=shortness of breath; bpm= beats per minute; BP=blood pressure
Chapter 4

Evaluation

Evaluation Summary

This patient was a 63 year-old female who presented with a 21-year history of multiple sclerosis that led to gradual decline in function with a recent moderate recovery and gains in functional mobility. This patient demonstrated poor vestibular function as measured by decreased performance during the foam and eyes closed conditions of the mCTSIB. Errors during the up/down test revealed diminished proprioception at the right ankle, bilateral knees and bilateral hips. Decreased sensation was found in dermatomes L5 and S1 on her right lower extremity via light touch sensation testing. She presented with decreased PROM with hip extension and dorsiflexion as measured by inability to reach or move beyond neutral as measured by gross visual estimation. Gait observation revealed poor motor control of the extensor muscle groups of the lower extremity as noted by the presence of genu recurvatum and Trendelenburg sign during gait. Poor coordination was demonstrated by errors during the heel on shin test. The patient’s spasticity was measured using the MAS and found to be present in her R ankle plantar flexor muscles but patient was currently taking anti-spasticity medications that may have confounded results. This patient was found to be at risk for falling according to the DGI score but no fall risk was determined according to ABC scale score. Her walking endurance was decreased as measured by
the 6MWT. The MFIS revealed the patient experience a significant impact of fatigue on her function and the MS-QOL described a decreased quality of life. Based on patient report she is household ambulatory with limited community mobility. The patient presented with impairments consistent with the diagnosis of multiple sclerosis and had shown an inconsistent disease progression. This patient was estimated to have an EDSS score of 6.0-6.5 and therefore classified as having moderate disability due to MS.

**Diagnostic Impression**

This patient was limited in her functional mobility due to impairments at the body structure and function level that include impaired vestibular function, decreased sensation, limited hip and ankle PROM, impaired proprioception and motor control, impaired coordination and presence of spasticity. These impairments led to limited function at the activity level and included decreased balance, balance confidence, walking endurance and impaired gait. This patient’s limited function affected her ability to participate fully in her community demonstrated by significant impact of fatigue, decreased quality of life and community ambulation and inability to participate fully in MS Walk.

**G-Codes**

Current with modifier:
G8978 CL: Mobility: (CL=At least 60 percent but less than 80 percent impaired, limited or restricted)

Based on the 6MWT distance: 116.4m

Goal with modifier:

G8979 CK: Mobility: (CK=At least 40 percent but less than 60 percent impaired, limited or restricted)

Goal 6MWT distance: 128.0m

Based on increase of 11.55m (MDC) in 6MWT

Prognostic Statement

Favorable prognostic indicators for this patient include female gender, onset of symptoms prior to age 40, and relatively late onset of cerebellar symptoms (poor coordination began in the last 5 years). This patient was taking disease modifying therapy medication which has been shown to reduce the severity and frequency of exacerbations. Her recent improvement in function and the patient’s enthusiasm and motivation to reach her goals are also positive prognosticators. Indicators of an unfavorable prognosis include her history of incomplete remissions, several year history of inability to ambulate and that the disease course has been typically progressive. These combined factors indicate fair prognosis mainly due to the length of time with significantly decreased mobility, which had possibly led to secondary
deconditioning and may therefore take much longer to see improvements than an individual with MS who was not deconditioned.

**Discharge Plan**

This patient was to be discharged from outpatient PT to continue living at home with her spouse. She is expected to continue with home exercise program independently and with support from spouse/caregiver.
# Plan of Care-Goals and Interventions

## Table 3
### Evaluation and Plan of Care

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>Short Term Goals (Anticipated Goals) (4 weeks)</th>
<th>Long Term Goals (Expected Outcomes) (8 weeks)</th>
<th>Planned Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestibular dysfunction</td>
<td>Patient to attempt eyes open, foam surface training and eyes closed firm surface training during mCTSIB.</td>
<td>Patient to perform eyes closed, foam surface condition of mCTSIB for 3 seconds.</td>
<td>Interventions are Direct or Procedural unless they are marked:  &lt;br&gt; (C) = Coordination of care intervention  &lt;br&gt; (E) = Educational intervention</td>
</tr>
<tr>
<td>Decreased proprioception</td>
<td>Patient to demonstrate balance exercises with proper form without cueing.</td>
<td>Patient to improve time in eyes closed firm surface condition of the mCTSIB to 30s.</td>
<td>Balance training: static and dynamic overground  &lt;br&gt; Seated: knee flexion and contralateral arm flexion in sitting, 2x5 each side  &lt;br&gt; Standing: rotation with item placement for external feedback, 3x5 each direction  &lt;br&gt; Progressed by:  &lt;br&gt; Increasing distance reached and adding height challenges  &lt;br&gt; Balance Master: A/P limits of stability for 8 seconds at 35%, 2x1 minute  &lt;br&gt; Progressed by:  &lt;br&gt; Gradual increase in setting up to 50% and adding L/R sway  &lt;br&gt; (E) HEP:  &lt;br&gt; Standing balance exercises: Standing on towels with head turns (3 directions, up/left/right), 2x10 each direction, 1s hold  &lt;br&gt; Seated knee/arm raise, 2x5 each side  &lt;br&gt; (C) Patient/Caregiver education: Review guarding and safety rules with both patient and spouse</td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**BODY FUNCTION OR STRUCTURE IMPAIRMENTS**
| Impaired gross hip extension and ankle DF PROM | Patient to demonstrate stretches with proper form without cueing. | Patient to demonstrate bilateral neutral hip extension in sidelying. | Patient to demonstrate ankle DF beyond neutral. | Motor control exercises: as described above
Standing glut sets: 10 second hold, 10x, daily
Standing marches: 2x10 each leg, 3 days/wk
Balance training: as described above
(E) HEP: same as above
Stretching: as described above
Manual stretching: PNF stretching in side lying, bilateral hip flexors, 10s contract, 10s relax, 3x each side
(E) HEP: same as above
| Impaired coordination | No measurable change expected in this time frame. | Patient to perform ambulation with 4WW on uneven surfaces in an open environment. | Motor control exercises: as described above
Gait training:
Treadmill training: Treadmill walking for 5 min at 0.1 mph, 0% incline. Patient unable to increase to normal walking speed due to anxiety.
Program altered to:
Overground ambulation training (uneven parking lot): 90s of walking overground with FWW, 45s of standing rest, for 5 rounds. Verbal cues for posture and forward gaze given periodically.
Progressed by:
Walk time increased to 2 min, rest for 1 min, for 5 rounds.
(E) HEP: same as above, add mental imagery sessions 2 times before MS walk
| Poor motor control of knee extension and hip abduction during gait | Patient to ambulate with 4WW with decreased incidence of B genu recurvatum and B | Patient to ambulate with 4WW with decreased incidence of B genu recurvatum and B | Biofeedback: Attempted electrical biofeedback over quadriceps for cueing during ambulation but unsuccessful reading due to excessive adipose
Motor control exercises: as described above
<table>
<thead>
<tr>
<th>Activity Limitations</th>
<th>Trendelenburg sign to 75% occurrence</th>
<th>Trendelenburg sign to 50% occurrence</th>
<th>(C) Referral to PCP for KAFO recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACTIVITY LIMITATIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased dynamic balance during gait</td>
<td>No measurable change expected during this time.</td>
<td>Patient to increase score on DGI to 19 or more.</td>
<td>Balance training: as described above (E) HEP: same as above</td>
</tr>
<tr>
<td>Decreased balance confidence</td>
<td>No measurable change expected during this time.</td>
<td>Patient to increase ABC scale score by 18.8%.</td>
<td>Balance training: as described above (E) HEP: as described above</td>
</tr>
<tr>
<td>Decreased walking endurance</td>
<td>No measurable change expected during this time.</td>
<td>Patient to walk 128.0m as measured by 6MWT.</td>
<td>Gait training: as described above (E) Physical activity recommendations: Patient issued a step count pedometer to monitor baseline activity. Patient given a goal of 1000 steps per day. Progressed by: Educated patient and spouse on importance of taking walks outside the home to prepare for the MS Walk and for physical health. (E) Cooling strategies: as described above</td>
</tr>
<tr>
<td><strong>PARTICIPATION RESTRICTIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant impact of fatigue on function</td>
<td>No measurable change during this time.</td>
<td>Patient will score &lt;34 on MFIS.</td>
<td>Gait training: as described above Motor control exercises: as described above (E/C) Physical activity recommendations: as described above (E) Energy conservation strategies: Patient educated on interval strategy for energy conservation. Patient educated to continue with 2:1 ratio if continues to be well tolerated. Patient already familiar with modified Borg RPE scale and to not exert over 7/10. (E) Cooling strategies: Ice pack application to shoulders after aerobic training and/or during rest breaks</td>
</tr>
</tbody>
</table>
| Diminished Quality of Life | No measurable change expected during this time frame. | Patient to demonstrate increase of 20% on subscales MSQOL-54, PH=59.30, MH=96.13. | (E) Cooling strategies: as described above  
| | | | (E) Physical activity recommendations: as described above  
| | | | (E) Energy conservation strategies: as described above  
| | | | Balance training: as described above  
| | | | (E) HEP: same as above  
| Decreased community ambulation | Patient will participate in 2 outdoor walks (10 min) with use of power chair for rest breaks in 4 weeks. | Patient to participate in 1 mile MS walk, alternating use of 4WW and power chair half the distance | (E) Cooling strategies: as described above  
| | | | (E) Physical activity recommendations: as described above  
| | | | Gait training: as described above  
| | | | (E) HEP: same as above  
| | | | (E) Mental imagery: Patient already familiar with mental imagery. Patient coached on keys to focus on when practicing mental imagery for MS Walk: Road/sidewalk obstacles, heat/weather, crowd, noise, etc.  
| Limited participation in MS Walk | Short term goal not applicable. | Patient to ambulate for 0.25 miles and then use power scooter for 0.25 miles during MS Walk with use of appropriate strategies. | (E) Cooling strategies: as described above  
| | | | (E) Physical activity recommendations: as described above  
| | | | Gait training: as described above  
| | | | (E) HEP: same as above  
| | | | (E) Mental imagery: as described above  
| | | | (E) Energy conservation strategies: as described above  

s = seconds, mCTSIB = modified clinical test of sensory in balance, A/P = anterior/posterior, L/R = left/right, HEP = home exercise program, 4WW= four wheeled walker, mph= miles per hour PCP = primary care physician, KAFO = knee ankle foot orthosis, DF= dorsiflexion, PROM= passive range of motion, PNF= proprioceptive neuromuscular facilitation, B=bilateral, m=meters, DGI=dynamic gait index, ABC=activities-specific balance confidence, 6MWT= Six minute walk test, MFIS= modified fatigue impact scale, MSQOL-54=Multiple sclerosis quality of life questionnaire, PH= physical health subscale, MH= mental health subscale, RPE= rating of perceived exertion
Plan of Care – Interventions

See Table 3.

Overall Approach

This patient’s treatment was based on clinical summary guidelines that incorporated an active lifestyle, modification of activities, task specific training and patient education.\(^9\) This approach emphasized patient independence and decreased reliance on assistive devices and other caregivers. For patients with MS of moderate severity the focus of treatment is on maintenance of functioning and reducing the risk of falls or deconditioning.\(^9\) The treatment provided was patient-centered and varied to maintain interest yet remain task-specific.

PICO question

For a patient with MS, which cardiovascular endurance training program impacts fatigue the least during the 6MWT, intermittent or continuous activity?

This article presents a cohort study in which patients with moderate MS were measured for fatigue levels pre and post intervention to determine if one intervention of intermittent walking (2 min walk, 2 min rest, 3 times) caused less fatigue than the other intervention of continuous walking (6 min walk). The authors found that intermittent walking was significantly less fatiguing for patients. This was found by comparing the differences in average fatigue levels reported and analyzed using a two-way, repeated measures ANOVA (p<0.05). Baseline differences were assessed for fatigue levels prior to performance of each 6MWT and no differences were found.
Each protocol was performed 1 week apart with half of the group performing the intermittent protocol the first week and the other half of the group performing the continuous protocol. The groups then switched protocols the following week. This avoided bias that may have occurred due to order of performance. Fatigue was measured pre and post intervention using the visual analog fatigue scale (VAFS) and the differences were compared.\(^{31}\)

Some limitations of the study include the limited sample size (N=30), lack of a control group and lack of data on distance walked. This is the only study I’ve found that tests a specific protocol for intermittent training and the effect on fatigue in patients with MS so this study is the best available at the moment. I’ve corresponded with one of the authors and they mentioned that there is a follow up study which evaluates the distances walked by patients when comparing the 2 protocols. That study is to be published soon and will hopefully include a larger subject sample. \(^{31}\)

This study is applicable to my patient because she is similar in level of disability, age and ambulation ability of the subjects studied. My patient does use anti-fatigue medication, which was cause for exclusion in the study, but the effects of training should not be affected by medication use. The results of this study were used to guide my treatment toward an intermittent aerobic training program rather than a continuous program.
## Chapter 6

### Outcomes

#### Table 4

<table>
<thead>
<tr>
<th>OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BODY FUNCTION OR STRUCTURE IMPAIRMENTS</strong></td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
</tr>
<tr>
<td>Vestibular function (mCTSIB)</td>
</tr>
<tr>
<td>Lower extremity passive range of motion (Gross visual estimate)</td>
</tr>
<tr>
<td>Motor control of quadriceps and hip abductors during gait (Gait observation)</td>
</tr>
</tbody>
</table>

#### ACTIVITY LIMITATIONS

<table>
<thead>
<tr>
<th><strong>Outcome</strong></th>
<th><strong>Initial</strong></th>
<th><strong>Follow-up</strong></th>
<th><strong>Change</strong></th>
<th><strong>Goal Met (Y/N)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional DGI score</td>
<td>12/24 (&lt;19 indicates fall risk)</td>
<td>16/24</td>
<td>+4 MDC=5</td>
<td>N</td>
</tr>
<tr>
<td>ABC Scale</td>
<td>55%</td>
<td>No follow up</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6MWT (distance in meters)</td>
<td>116.4m</td>
<td>130.2m</td>
<td>+13.7m MDC= 11.55m</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------</td>
<td>--------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>Pre-test exertion (modified Borg scale):</td>
<td>3/10</td>
<td>Pre-test exertion (modified Borg scale):</td>
<td>0/10</td>
<td></td>
</tr>
<tr>
<td>Pre-test SOB (modified Borg scale):</td>
<td>0/10</td>
<td>Pre-test SOB (modified Borg scale):</td>
<td>0/10</td>
<td></td>
</tr>
<tr>
<td>Pre-test pulse: 68 bpm, rhythmic, weak</td>
<td>Pre-test pulse: 92 bpm, rhythmic, weak</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test BP: 143/96 (measured with patient supplied wrist device)</td>
<td>Pre-test BP: unable to measure due to lack of appropriate size cuff and wrist device malfunction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test exertion (modified Borg scale):</td>
<td>5/10</td>
<td>Post-test exertion (modified Borg scale):</td>
<td>4/10</td>
<td></td>
</tr>
<tr>
<td>Post-test SOB (modified Borg scale):</td>
<td>2/10</td>
<td>Post-test SOB (modified Borg scale):</td>
<td>0/10</td>
<td></td>
</tr>
<tr>
<td>Post-test pulse: 79 bpm, rhythmic, weak</td>
<td>Post-test HR: 100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test BP: unable to measure due to lack of appropriate size manual BP cuff and wrist device malfunction</td>
<td></td>
<td></td>
<td></td>
<td></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><strong>HEP compliance</strong></td>
<td>No HEP in place at start of episode of care.</td>
<td>Pt reported completion of HEP about 50% of time.</td>
<td>N/A</td>
<td>N</td>
</tr>
<tr>
<td><strong>MFIS</strong></td>
<td>51/84 (&gt;38 indicates fatigue)</td>
<td>33/84</td>
<td>-18 pts MDC=16.2 pts</td>
<td>Y</td>
</tr>
<tr>
<td><strong>MS-QOL-54</strong></td>
<td>Physical Health Composite= 49.42 Mental Health Composite= 80.11</td>
<td>Physical Health Composite= 58.44 Mental Health Composite= 69.42</td>
<td>PH= +9.02 MH= -10.69</td>
<td>N</td>
</tr>
<tr>
<td><strong>Participation in Social activities</strong></td>
<td>Pt unable to go to casino without use of powered scooter</td>
<td>Pt made several trips to casino without use of powered scooter.</td>
<td>Pt reported increase in social events participation.</td>
<td>N</td>
</tr>
</tbody>
</table>
EO/Firm= eyes open firm condition, EC/Firm= eyes closed firm condition, EO/Foam= eyes open foam condition, EC/Foam= eyes closed foam condition, s = seconds, mCTSIB = modified clinical test of sensory in balance, pt= patient, NT= not tested, MDC= minimal detectable change, HEP = home exercise program, 4WW= four wheeled walker, DF= dorsiflexion, PROM= passive range of motion, B=bilateral, m=meters, DGI=dynamic gait index, ABC=activities-specific balance confidence, 6MWT= Six minute walk test, MFIS= modified fatigue impact scale, MSQOL-54=Multiple sclerosis quality of life questionnaire, BP= blood pressure, SOB= shortness of breath, HR= heart rate, RPE= rating of perceived exertion
Discharge Statement

This patient participated in outpatient physical therapy once a week for a total of 8 weeks to treat impairments and activity limitations related to multiple sclerosis. The patient was treated for vestibular dysfunction, poor motor control, impaired coordination, impaired balance, decreased balance confidence and walking endurance, gait deviations, adverse impact of fatigue, decreased quality of life and restricted social and community participation. These impairments and limitations were treated with gait training, stretching and motor control exercises, manual techniques, balance training, patient education and a home exercise program. At the end of the 8 week session, this patient achieved goals for walking endurance as measured by 6MWT, impact of fatigue as measured by MFIS and increased community participation per patient report. The patient reported noticeable improvements over the 8 week period in her ability to participate in social events without excessive fatigue as well as increasing her cardio training at the MS achievement program from 12 minutes of cardio on elliptical to 20 minutes. Despite not making significant measurable gains in dynamic balance, this patient continued to attempt new challenges in that domain with no report of adverse effects. This patient was independent with most of her home exercises but some of the exercises regarding balance training required minimal supervision from her spouse/caregiver. She was discharged from therapy to her home with her spouse.
DC G-Code with modifier

*G8980 CK: Mobility: (CL=At least 40 percent but less than 60 percent impaired, limited or restricted)*

*Based on the follow-up 6MWT distance: 130.2m*
Chapter 7

Discussion

This patient demonstrated improvement and met her goal of participating in the MS Walk scheduled 1 week after completion of this episode of care. This increase in participation was likely due to gains made in walking endurance, decreased impact of fatigue and increased community ambulation.

Significant improvements were not seen in overall quality of life measures, gait quality or dynamic balance according to each respective outcome measure. This may be due to the limited number of treatments and inadequate progression of her home program due to this patient’s high levels of anxiety and fear of some physical activities as evidenced by the low ABC scale score, presence of anxiety and decreased willingness to continue more challenging balance tasks. Additional gains may have been possible if the patient were more consistent with her home exercise program. Patient education was a key component of this treatment program and future progress is expected based on the implementation of the home exercise program and strategies that were developed. The patient was given multiple key phrases to focus on and she responded well to more focused and consistent feedback. She reported certain cues had become her mantras during activity. This gave her the tools to continue to perform the recommended activities even as
changes occurred and this allowed her to potentially achieve the higher repetition and load that would be optimal for possible improvement in the future.

An unexpected outcome was the significant decline in the mental health subscale of the MSQOL-54 as the patient repeatedly described her excitement over new gains each week. Specific follow-up on the cause of the decreased mental health QOL would be warranted in future episodes of care.

Modifications to treatment of future patients of a similar presentation would include an increased number of visits for follow-up and progression of ambulation tasks. This patient may have benefitted from a more open environment with simulation of the MS Walk race day environment to provide a more task-specific intervention. The timing of the treatment session did not allow for enough visits prior to the race day to appropriately progress her for additional stimulus during ambulation training. Additional treatment for trunk control may have been beneficial for this patient. In the future I would test the trunk control of this patient using the trunk impairment scale to determine if trunk weakness or control was a potential contributor to her gait abnormalities and address her postural goals.

A thorough assessment of this patient’s upright posture would have been beneficial. For instance, the Thomas test and a seated postural control test could have been performed to differentiate between the two possible underlying impairments of weakness or muscle length problems. Gait speed may have been a
more appropriate measure rather than gait quality, as improvements in many of the impairments listed would have likely contributed to increased gait speed. Coordination assessment may have proven more reliable if either the heel to shin test was performed in supine or if a rebound test was performed. However, the heel on shin test also provided an improved picture of this patient’s lower extremity function during a more walking specific task. Sensation testing of the lower extremities should have been performed with a monofilament test in order to quantify the level of impairment. Once quantified, additional education would have been given to the patient regarding care and inspection of feet. Finally, assessment of this patient’s blood pressure was inconsistent due to lack of appropriate size cuff and unreliable replacement device. In the future I would have acquired an appropriate size manual blood pressure cuff to ensure accuracy and safety.
References


