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# Balance And Strength Interventions For An Older Individual With Peripheral Polyneuropathy: A Case Report

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1           Balance and Strength Interventions for an Older Individual with  
2                           Peripheral Polyneuropathy: A Case Report

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7  
8 The patient signed an informed consent allowing for the use of medical information and  
9 photographs for this report and received information on the institution's policies regarding the  
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11  
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15  
16 Key Words: Peripheral Neuropathy, Balance Training, Strength Training, OTAGO

24 **ABSTRACT**

25 Background and Purpose: Peripheral polyneuropathy (PPN) is a condition resulting from damage  
26 to the peripheral nervous system, causing sensory abnormalities (e.g. tingling, burning, and loss  
27 of sensation) occurring distally to proximally. Individuals with PPN experience proprioceptive  
28 sensory loss and muscle weakness, resulting in decreased functional mobility. A common cause  
29 of PPN is diabetes mellitus, however 20-25% of cases are deemed idiopathic. Interventions of  
30 balance training and lower extremity strengthening have been shown to have a small positive  
31 effect on the progression of PPN. The purpose of this case report is to describe the physical  
32 therapy (PT) management of an elderly patient with PPN, elevated fall-risk, and deconditioning.

33 Case Description: An 81-year-old male who presented with complaints of decreased bilateral  
34 foot sensation, unsteadiness in gait, and lower extremity (LE) weakness secondary to a diagnosis  
35 of LE PPN received PT twice per week for nine weeks. The PT plan of care included LE  
36 strengthening, balance training, and aerobic conditioning. Outcomes included the Lower  
37 Extremity Functional Scale (LEFS), Activities-Specific Balance Confidence (ABC) Scale,  
38 Timed Up & Go (TUG), and Five Times Sit to Stand (5xSTS).

39 Outcomes: The LEFS improved from 15/80 to 33/80 and the ABC scale improved from 27.5% to  
40 47.5%. The TUG and 5xSTS times improved from 14.75 seconds to 11.81 seconds and from  
41 27.6 seconds to 18.85 seconds, respectively.

42 Discussion: Interventions of standing balance training and LE strengthening exercises are safe  
43 and may have contributed to improving the patient's functional mobility despite his progressive  
44 PPN. Future research would benefit current literature by investigating the effectiveness of  
45 standing balance exercises with internal and external perturbations in combination with LE  
46 strengthening exercises in patients with PPN.

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49 **Background and Purpose**

50       Peripheral polyneuropathy (PPN) is described as a condition resulting from damage of  
51 the peripheral nervous system.<sup>1</sup> The most common form of PPN occurs in a distal and  
52 symmetrical pattern, often affecting the toes and the soles of the feet. Sensory abnormalities such  
53 as numbness, tingling, paresthesias, or burning are common symptoms experienced by those  
54 with PPN.<sup>1</sup> The most common cause of polyneuropathy is diabetes mellitus, however in 20-25%  
55 of cases no cause can be determined.<sup>1</sup> It has been found that in some cases of idiopathic PPN,  
56 individuals display glucose intolerance or prediabetes.<sup>1</sup> Treatment for PPN, and its associated  
57 symptoms, typically consists of symptom management, as well as preventative and palliative  
58 therapy, including both pharmacological interventions and physical therapy (PT). Presentation of  
59 PPN is unique to each patient, thus there is no specific treatment yet described in the scientific  
60 literature. As the disease progresses, many patients require the use of adaptive equipment and/or  
61 assistive devices.<sup>1</sup> Although not fatal, patients can experience significant impairment of physical  
62 function and an increased risk for falls.<sup>2</sup> Abnormal sensations and loss of sensation tends to  
63 spread proximally. Individuals with PPN can be impacted functionally, experiencing  
64 proprioceptive sensory loss, as well as general weakness of extensor muscles, thus resulting in  
65 unsteadiness of gait and impaired balance.<sup>1</sup>

66       According to the scientific literature, PT interventions of balance training and lower  
67 extremity (LE) strengthening have been shown to have only a small positive effect on the  
68 progression of PPN. However, the same studies have found that such an intervention program is  
69 safe for sedentary individuals with PPN to participate in, as it did not cause an increase in the  
70 their fall risk.<sup>3</sup> Another study found that following participation in a strength and balance  
71 training program, individuals experienced significantly fewer falling episodes.<sup>4</sup>

72 Growing literature suggests the implementation of strength and balance-training exercises  
73 for benefitting community-dwelling adults at a high risk for falls; however, there are few  
74 evidence-based treatment strategies available to practicing clinicians specific to the diagnosis of  
75 PPN.<sup>5</sup> The purpose of this case report is to describe the PT management of an elderly  
76 community-dwelling patient with idiopathic PPN, elevated fall-risk, deconditioning, and a  
77 history of bilateral total knee and hip arthroplasties.

### 78 **Patient History & Systems Review**

79 The patient was an 81-year-old male who presented to PT at a hospital-based outpatient  
80 rehabilitation clinic with chief complaints of decreased bilateral feet sensation, unsteadiness in  
81 gait, and bilateral LE weakness secondary to a diagnosis of bilateral LE PPN. The patient sought  
82 out PT following an instance two months prior when, without realizing due to his sensory  
83 deficits in both feet, he had dislocated and lacerated his right great toe. He stated that he was  
84 unaware of his injury until he looked down while in the shower and saw that he was bleeding.  
85 Soon after, he went to the emergency room and had the joint reduced without anesthesia. He also  
86 reported that he had experienced a fall two months prior without injury.

87 The patient's relevant past medical history included bilateral idiopathic PPN, diagnosed  
88 two years prior to the episode of care (EOC), pre-diabetes mellitus, cardiomyopathy, atrial  
89 fibrillation, morbid obesity, and bilateral total hip and total knee arthroplasties. He utilized  
90 various medications (see Table 1) to control his cardiovascular comorbidities. A ½ inch custom  
91 heel lift in his left shoe of to accommodate a leg length discrepancy on his left side was also  
92 noted. Electromyography testing performed during a neurologist consult two years prior to EOC  
93 found mild to moderate axonal neurogenic changes in the bilateral LEs. The consulting  
94 neurologist did not attribute the PPN diagnosis to pre-diabetes. His blood work regarding the  
95 classification of pre-diabetes status has remained stable since this initial diagnosis. He had been

96 taking three 600 mg doses of Gabapentin daily to treat the symptoms of PPN with little success,  
97 given the progression of the patient's sensory loss.

98       Upon initial evaluation (IE), the patient stated that his primary goal for PT was to improve  
99 his balance and strength in his legs, and reduce his risk for future falls. He denied complaints of  
100 foot pain. The patient reported to PT ambulating with a straight cane, stating that the cane was  
101 used primarily for community ambulation and he was independent in household ambulation  
102 without the use of an assistive device. The patient lived in a two-story home with a first floor set  
103 up in the northeast for half of the year and spent the winter in the south. He was a retired  
104 insurance salesman who received support from both his children and his female partner at home.  
105 The entrance of his northeast home was accessed with three steps with a single railing. Review  
106 of the patient's history and systems review revealed impairments of the musculoskeletal and  
107 neuromuscular systems (see Table 2). The patient presented as an excellent candidate for a case  
108 report due to his complex past medical history, along with his enthusiasm for, and compliance  
109 with, PT. The patient verbalized and documented his consent to participate in this case report.

## 110 **EXAMINATION**

### 111 **Tests and Measures**

112       Considering the patient history, and impairments of the musculoskeletal and  
113 neuromuscular systems indicated during the systems review, a variety of tests and measures were  
114 administered (see Table 3). Active range of motion (ROM) of the right knee was measured in  
115 sitting using goniometry as described by Norkin.<sup>6</sup> Bilateral LE strength was assessed in sitting  
116 via manual muscle testing (MMT) in accordance with guidelines described by Kendall.<sup>7</sup>  
117 According to available literature, MMT has been shown to have good reliability and concurrent  
118 validity.<sup>8</sup> Observation of the patient's gait was performed as the patient walked to the treatment  
119 room. Comfortable gait speed, ambulating with a straight cane, was also taken over a distance of

120 four meters with the use of a stopwatch (see Table 3). Recent literature has suggested that gait  
121 speed is a valid, reliable, and sensitive measure used to assess functional mobility and patient  
122 response to procedural interventions.<sup>9</sup> An antalgic gait pattern was observed, along with impaired  
123 bilateral step length, due to limitation in his right knee ROM. A Timed Up & Go (TUG) test was  
124 also performed. The TUG is a timed test in which the patient is instructed to rise from a standard  
125 chair with arm rests, walk three meters at a safe and comfortable pace, turn, and then walk back  
126 to the chair and return to sitting.<sup>10</sup> Timing begins at “go” and stops when the patient is seated.<sup>10</sup>  
127 The TUG has been found to be a reliable and valid means of assessing mobility, balance, and  
128 risk for falls.<sup>11</sup> A Five Times Sit to Stand Test (5xSTS) was also performed during the patient’s  
129 initial visit, in which the amount of time it takes for the patient to stand from a chair is used to  
130 assess risk of recurrent falls with established cut off scores according to fall risk category.  
131 Research studies by Bohannon<sup>12</sup> and Schaubert<sup>13</sup> found that the 5xSTS test had an excellent  
132 reliability and construct validity. The patient also completed a Lower Extremity Functional Scale  
133 (LEFS) during his initial visit to PT, providing a quantitative self-assessment of the patient’s  
134 functional impairments at baseline and upon discharge from therapy. Research performed by  
135 Binkley et al.<sup>14</sup> suggests that the LEFS is a reliable and valid measure, sensitive to change with  
136 an established Minimally Clinically Important Difference (MCID) of 9 points out of 80 total.

137 A plan to administer an Activities-Specific Balance Confidence (ABC) Scale and a  
138 tandem stance balance time test was made in order to gauge the patient’s confidence in his  
139 balance abilities, as well as to quantify observable improvements in balance impairment. The  
140 ABC Scale is a 16-item subjective patient-reported outcome measure, in which patients rate their  
141 balance on a rating scale of 0% to 100% confidence in performing various ambulatory and  
142 standing activities.<sup>15</sup> The ABC Scale has excellent correlative construct validity with the TUG  
143 and excellent reliability.<sup>16,17</sup> Timed tandem stance balance, also known as the Sharpened

144 Romberg test, consists of placing one foot directly in front of the other, heel in contact with the  
145 toe.<sup>18</sup> Franchignoni and colleagues<sup>19</sup> found it be both high in test-retest and interrater reliability.

146 **Clinical Impression: Evaluation, Diagnosis, Prognosis**

147 The tests and measures performed, as well as the history taken, during the initial  
148 examination revealed both signs and symptoms consistent with a balance/gait impairment  
149 associated with PPN. The patient's observed impairments were primarily due to his medical  
150 diagnosis of PPN (ICD-10 code G90.09). The presence of the PPN and a fear of falling were the  
151 primary concerns of the patient. Observations of impaired functional mobility, balance, and  
152 strength were supported by the results elicited by MMT, a TUG, a 5xSTS, sensation screen,  
153 unilateral stance timed balance, gait speed, as well as a previous fall event occurring less than 90  
154 days prior. The patient was modified independent in ambulation, as well as transfers to and from  
155 a chair, given the use of his hands or his assistive device. Prognosis was determined to be good  
156 due the patient's enthusiasm and willingness for compliance with PT. However, potential  
157 barriers for improvement were deemed to be the possible progressive and irreversible nature of  
158 PPN and the patient's lack of ROM in the right knee. Limitations in knee ROM have been shown  
159 to contribute to gait and balance dysfunction.<sup>20</sup> At the time of IE, he was also advised to attend  
160 local Tai-Chi classes to help reduce his risk for falling. According to current literature,  
161 community-based Tai Chi was found to prevent decline in both balance and gait impairment  
162 among older adults.<sup>21</sup> The patient also revealed during the EOC that he was only able to tolerate  
163 the Tai Chi classes in sitting. A randomized controlled trial by Lee, Hui-Chan, and Tsang<sup>22</sup> found  
164 that seated Tai Chi exercises improved sitting balance in older adults. Current literature does not  
165 examine whether seated Tai Chi exercises can improve standing balance.

166 It was decided that PT frequency and duration would consist of two visits per week for  
167 six to ten weeks. At the tenth visit, all tests and measures previously used would be re-



168 administered. Interventions consisted of aerobic exercises, balance training, LE strengthening  
169 exercises, and gait training. Short and long-term goals for PT are laid out in Table 4.

170 **Intervention and Plan of Care**

171 **Coordination, Communication, and Documentation**

172 Communication and coordination was established with the patient's primary care  
173 provider upon initiation of the EOC. Written communication set out to provide updates regarding  
174 the patient's progress. Observations in the measures of timed static standing balance, gait speed,  
175 TUG score, reported pain levels, 5xSTS time, as well as patient reported functional outcome  
176 measures, such as the LEFS, were documented at the tenth visit and at time of discharge. At the  
177 tenth visit an additional patient reported outcome measure, the ABC Scale, was completed by the  
178 patient. The ABC Scale was used to measure the possible change in patient's perceived balance  
179 confidence levels from the tenth visit to patient discharge. Coordination and communication was  
180 also established between the supervising physical therapist and the student physical therapist  
181 regarding the patient's POC. Both the student and the supervising PT provided verbal instruction  
182 and/or demonstration of the exercise program carried out during each visit. The exercise program  
183 included interventions of therapeutic exercise, balance training, and neuromuscular reeducation.  
184 Throughout the EOC, the patient was monitored by both therapists to ensure both proper  
185 technique and body mechanics, as well provide adequate safety and guarding. The  
186 documentation and electronic health record software system, Epic (Epic Systems Corporation,  
187 Madison, WI), was utilized throughout the EOC.

188 Patient education was provided to the patient regarding the POC, prognosis, along with  
189 expected outcomes and goals to be met for PT during the IE. The patient was initially given a  
190 small number of standing LE strengthening exercises, as well as a more functional exercise of  
191 performing sit to and from stand transfers. Over the course of the episode of care, the HEP was

192 updated when the patient demonstrated improvements in strength and activity tolerance. The  
193 HEP was to be carried out daily, one to three sets a day. However, the patient admitted during  
194 the course of care, that he was not 100% compliant in his designated HEP, often going a day or  
195 more without performing his HEP. Despite this, the patient arrived regularly to PT with a high  
196 level of motivation and a willingness to work hard. Throughout the EOC, the busyness of the  
197 clinic resulted in an occasional lack of available exercise equipment, ultimately affecting the  
198 consistency of implemented procedural interventions during each daily visit. Thus, the PT was  
199 then unable to, at times, guide the patient through the intended intervention plan, substituting  
200 with different interventions as needed within the given appointment time. This limitation in care  
201 was further exaggerated by the patient's lack of compliance with his HEP.

202         Upon the initial visit, the patient was scheduled for PT twice weekly for 6-10 weeks. The  
203 therapist explained to the patient the possibility of the duration of care being either shorter or  
204 longer depending on the patient's progression of care and the attainment of set goals. Due to  
205 scheduling conflicts, there were weeks in which the patient was only able to attend PT once.

206         At the first visit, the patient was given standing LE exercises, carried out in the parallel  
207 bars to allow the patient to use his upper extremities (UE) on a sturdy surface to help maintain  
208 balance. These initial exercises included standing double leg calf raises, standing alternating  
209 marching, standing hip abduction and extensions, and sit to stands from a chair with use of the  
210 armrests. All exercises were performed with bilateral LEs unless otherwise stated. All five of  
211 these exercises are components of the Otago Exercise Program<sup>23</sup> to prevent falls in older adults.  
212 The Otago exercise program consists of exercises designed to develop muscle strength and  
213 flexibility, along with retrain balance and improve reaction times, as these are the most easily  
214 modifiable factors contributing to risk for falls.<sup>23</sup>

215         During the second therapy session, the patient began treatment with an aerobic warm-up

216 exercise on the NuStep TRS Recumbent Cross Trainer (NuStep Inc., Ann Arbor, MI) for 5  
217 minutes at a low resistance. The NuStep is a commercial grade device that provides a seated  
218 reciprocal UE/LE flexion/extension exercise movement against graded loads, stimulating the  
219 motion of walking.<sup>24</sup> Resistance on the NuStep was progressed overtime, starting at level 3 of 10  
220 levels. Research by Morrison and colleagues found that following an aerobic exercise program,  
221 individuals with diabetic PN showed improvements in gait speed and improved postural  
222 coordination, which is equated with greater stability.<sup>4</sup> Beginning at the second visit, the patient  
223 was instructed to warm-up using the NuStep and then to perform the same exercises from the  
224 first visit. The patient was then introduced to perform additional therapeutic exercises including  
225 lateral stepping with a REP Band (Magister Corporation, Chattanooga, TN) loop placed around  
226 both ankles and forward step-ups onto a 6-inch step. A level 2 REP Band with a resistance level  
227 of 5 pounds at 100% extension was utilized initially. Later in the EOC, the patient was  
228 progressed to a level 3 REP Band with a resistance level of 6.5 pounds at 100% extension.<sup>25</sup> The  
229 patient reported significant pain and discomfort in his right knee during the step-up exercise,  
230 which was thus discontinued. A study by Inacio et al.<sup>26</sup> found that a lack of hip abduction  
231 strength was associated with impaired balance and risk for falls. The patient was also instructed  
232 to rock back and forth, in a slow and controlled manner while standing on a Fitterfirst  
233 Professional Rocker Board (Fitter International Inc., Calgary, Alberta) in both the frontal and  
234 sagittal planes. The rocker board consisted of a 20" x 20" wooden board mounted on two  
235 polypropylene hemispheres that could be tilted on a single-plane up and down three inches.<sup>27</sup>  
236 Current evidence suggests that a ten-week training program using a rocker board produced  
237 significant improvement in both balance and confidence in older community dwelling adults.<sup>28</sup>  
238 The patient required frequent seated rest breaks throughout the 45-minute treatment time.

239           During the third visit, the patient was introduced to forward and lateral stepping over a 1-

240 inch tall beam. He was instructed to bring his foot as high as he could, as if he was stepping over  
241 a much larger hurdle. This was intended to encourage total foot clearance and stable gait given  
242 the need to negotiate potential obstacles. This, and all LE strengthening exercises, were  
243 periodically progressed with an increase of repetitions and the inclusion of ankle weights. The  
244 hurdle exercise was also later progressed using a 4-inch tall object to step over (see Table 5 for a  
245 detailed list of exercise interventions).

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264 **TIMELINE**



266 **OUTCOME**

267 Over the course of 18 PT visits, the patient demonstrated significant subjective and  
268 functional improvements. Upon discharge, the patient's LEFS score had improved from 15/80 to  
269 33/80, indicating a reduction in disability of 22.5%. The change reported in this outcome  
270 measure from IE to the point of discharge is double the value of the reported MCID.<sup>14</sup> From the  
271 tenth PT visit to PT discharge (18<sup>th</sup> visit), the patient also reported a positive change in the ABC  
272 Scale, which more than doubled his initial score of 27.5% to 57.5%. Recent literature revealed  
273 that the minimal detectable change (MDC) for the ABC Scale was 16.94%.<sup>29</sup>

274 Additionally, the patient demonstrated some improvement in timed measures at the end  
275 of the EOC. His TUG and 5xSTS times went from 14.75 seconds to 11.81 seconds, and from  
276 27.6 seconds to 18.85 seconds, respectively. According to relevant literature, cut-off score  
277 indicating risk for falls for the TUG is 13.5 seconds among community dwelling adults,<sup>30</sup> while  
278 the MDC is 2.49 seconds.<sup>31</sup> Research by Goldberg et al.<sup>32</sup> reported an MDC of 2.5 seconds for  
279 the 5xSTS. Furthermore, timed tandem stance balance improved overall during the EOC,  
280 increasing by five seconds. However, the patient's comfortable gait speed did decrease by a total  
281 0.15 m/s from IE to discharge.

282 Right knee flexion AROM increased from 90 degrees to 95 degrees. This change was  
283 negligible due to the reported standard error of measurement of 6.6 degrees.<sup>33</sup> MMT performed  
284 at discharge showed improvement in bilateral knee extension and ankle plantarflexion, to 5/5 and  
285 4/5, respectively. Tests and measures taken at IE and discharge can be found in Table 3.

286 **DISCUSSION**

287 The purpose of this case report was to describe a strengthening and balance training  
288 program for an elderly community-dwelling patient with idiopathic PPN, elevated fall-risk,  
289 deconditioning, and a history of bilateral total knee and hip arthroplasties. The POC was designed

290 to address the patient's impairments and goals for therapy and was based on applicable research  
291 on beneficial strength and balance training for older adults and clinical judgment. Over the  
292 course of the EOC, the patient demonstrated improvements in balance, LE strength, patient  
293 reported outcome measures, and normalized functional outcome measures (TUG and 5xSTS).

294         The outcome measures at discharge suggested that the combined LE strengthening,  
295 aerobic conditioning, and balance training program might have contributed to the patient's  
296 functional improvements and decreased fall risk, as indicated by the improved TUG and 5xSTS  
297 scores. One limitation to this study was how busy the clinic was throughout the EOC, making the  
298 equipment needed for each visit often occupied, which affected the patient's POC visit to visit.

299         Positive prognostic indicators included the patient's enthusiasm for, and compliance with,  
300 PT in the clinic. He also had familial support at home in the form of positive reinforcement for  
301 the positive changes seen by his partner and by regularly accompanying him during his visits that  
302 contributed to his overall success in PT. Potential negative prognostic factors included his lack of  
303 compliance with his HEP, his multiple comorbidities, and the progressive nature of PPN.

304         Overall, the outcomes presented in this case suggest that the designed POC, featuring LE  
305 strengthening exercises highlighted in the Otago exercise program and balance training  
306 exercises, were neither unsafe nor caused an increase in fall risk for the patient. It could be  
307 suggested that the POC was beneficial to the patient, improving his functional mobility and a  
308 self-rated balance confidence despite his unchanging PPN. Future research would benefit current  
309 literature by investigating the effectiveness of balance exercises with internal and external  
310 perturbations in combination with functional LE strengthening exercises for older adults with  
311 PPN.

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409 **TABLES and FIGURES**

410 **Table 1. Patient Medications**

<b>Medications/Dosage</b>	<b>Instructions</b>
Hydrocodone-acetaminophen 325 mg	Take 1-2 Tab orally 3 times daily as needed for pain
Warfarin 5 mg	Take 1.5 tabs orally 4 days/week, take 1 all other days
Digoxin 0.25 mg	Take 1 tab orally daily
Doxazosin 4 mg	Take 1 tab orally every evening
Gabapentin 600 mg	Take 1 tab orally three times daily
HydrOXYzine 10 mg	Take 1-2 tabs at bedtime as needed for leg cramps
Metoprolol Succinate 100 mg	Take 1 tab orally daily
Naproxen 500 mg	Take 1 tab orally as needed
Ranitidine 150 mg	Take 1 tab orally 3 times daily as needed for heartburn

411

412 **Table 2. Systems Review**

<b>Systems Review</b>			
<b>Cardiovascular/Pulmonary</b>	Unimpaired		
<b>Musculoskeletal</b>	<table border="1"> <tr> <td>R LE AROM: Impaired Impaired/Limited Knee Flexion R LE Gross Strength: Impaired</td> <td>L LE AROM: WFL L LE Gross Strength: Impaired</td> </tr> </table>	R LE AROM: Impaired Impaired/Limited Knee Flexion R LE Gross Strength: Impaired	L LE AROM: WFL L LE Gross Strength: Impaired
R LE AROM: Impaired Impaired/Limited Knee Flexion R LE Gross Strength: Impaired	L LE AROM: WFL L LE Gross Strength: Impaired		
<b>Neuromuscular</b>	Impaired Static and Dynamic Standing Balance		
<b>Integumentary</b>	Unimpaired		
<b>Communication</b>	Unimpaired		
<b>Affect, Cognition, Language, Learning Style</b>	Unimpaired Language: English Learning Style: Verbal, Demonstration		

413 Right (R), left (L), Lower Extremity (LE), Active Range of Motion (AROM), Within Functional Limits (WFL)

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416 **Table 3. Tests & Measures**

<b>Results</b>	<b>Initial Evaluation</b>		<b>Discharge</b>	
<b>Joint &amp; Muscle Actions</b>	<b>Right LE</b>	<b>Left LE</b>	<b>Right LE</b>	<b>Left LE</b>
<b>Active Range of Motion</b>				
Knee	0-90°	WFL	0-95°	WFL
<b>Manual Muscle Testing</b>				
Hip Flexion	4/5	4/5	4/5	4/5
Knee Flexion	4+/5	4+/5	4+/5	4+/5
Knee Extension	4/5	4/5	5/5	5/5
Ankle Dorsiflexion	4-/5	4+/5	4-/5	4+/5
Ankle Plantarflexion	3/5	3/5	4/5	4/5
<b>Functional Outcome Measures</b>				
<b>Tests</b>	<b>IE</b>	<b>10<sup>th</sup> Visit</b>	<b>Discharge</b>	
<b>Lower Extremity Functional Scale (LEFS)</b>	15/80 (81.25% Impaired)	22/80 (72.50% Impaired)	33/80 (58.75% Impaired)	
<b>Activities-specific Balance Confidence Scale</b>	Not Collected	440/1600 (27.5%)	920/1600 (57.5%)	
<b>Timed Up &amp; Go Test (With a Straight Cane)</b>	14.75 seconds	13.85 seconds	11.81 seconds	
<b>Tandem Stance Balance</b>	Not Collected	3 seconds	8 seconds	
<b>Five Times Sit to Stand Test (*Required Use of Hands)</b>	27.60 seconds	22.34 seconds	18.85 seconds	
<b>Gait Speed (*with use of straight cane)</b>	0.78 m/s	0.64 m/s	0.63 m/s	

417 Lower Extremity (LE), Within Functional Limits (WFL), Initial Evaluation (IE)

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422 **Table 4. Goals for Therapy**

<b>Short Term Goals to be completed in 2 weeks</b>	<b>Status at Discharge</b>
1. Patient will demonstrate independence and compliance with HEP	Not Met
<b>Long Term Goals to be completed in 8 weeks</b>	
1. Improve LEFS score from 15/80 to 40/80	Not Met, but improved.
2. Improve Gait Speed from 0.78 m/s to 0.9 m/s.	Not Met
3. Improve TUG from 14.75 seconds to $\leq$ 13.5 seconds.	Met
4. Improve 5xSTS from 27.6 seconds to $\leq$ 20 seconds.	Met
5. Improve Bilateral Knee Extension, Flexion, Hip Flexion, Ankle Plantarflexion, and Ankle Dorsiflexion strength to a 5/5 using MMT	Not Met
6. Improve Tandem Stance Balance from 3 seconds to 10 seconds.	Not Met, but improved.

423 Home Exercise Plan (HEP), Lower Extremity Functional Scale (LEFS), Timed Up & Go (TUG), Five Times Sit to  
 424 Stand (5xSTS), Manual Muscle Testing (MMT)

425  
 426 **Table 5. Procedural Interventions.**

	<b>Rx Day 1</b>	<b>Rx Day 2</b>	<b>Rx Day 3</b>	<b>Rx Day 4</b>	<b>Rx Day 5</b>
<b>Calf Raises</b>	1x10	1x15	1x15	1x15	
<b>Sit to Stand</b>	1x5				2x5 With Suspension straps (TRX)
<b>Standing Hip Abduction</b>	1x10	1x10		1x15	
<b>Standing Marching</b>	1x10	1x10			
<b>Standing Hip Extension</b>	1x10	1x10		1x15	

<b>Lateral Stepping with a REP Band</b>		1x60ft Level 2		1x60ft Level 2	1x60ft Level 3
<b>Forward Step Ups with 6” Step</b>		1x10, Discharged from POC			
<b>Rocker Board: Frontal and Sagittal Planes</b>		2x1 minute each	2x1 minute each	2x1 minute each	2x1 minute each
<b>NuStep</b>		1x5 minutes, Level 3	1x5 minutes, Level 4	1x5 minutes, Level 4	1x6 minutes, Level 4
<b>Hurdles: Forward and Lateral Stepping</b>			2x5 1” hurdles each way	2x5 1” hurdles each way	2x5 1” hurdles each way
<b>Tandem Stance on Firm Surface</b>		2x30 seconds, attempts	2x30 seconds, attempts	2x30 seconds, attempts	2x30 seconds, attempts
<b>Staggered Stance on Foampad</b>					1x2 minutes total with Trunk Rotations
	<b>Rx Day 6</b>	<b>Rx Day 7</b>	<b>Rx Day 8</b>	<b>Rx Day 9</b>	<b>Rx Day 10</b>
<b>Calf Raises</b>	1x15	1x15	1x15	1x15	
<b>Sit to Stand</b>	2x5 With Suspension straps (TRX)			TRX Strap Mini Squat 2x8	
<b>Standing Hip Abduction</b>			1x10 with 3# ankle weights	1x10 with 3# ankle weights	
<b>Standing Hip Extension</b>			1x10 with 3# ankle weights	1x10 with 3# ankle weights	
<b>Calf Stretch/ Seated Hamstring Stretch</b>	2 x 30 seconds	2 x 30 seconds		2 x 30 seconds	

<b>Lateral Stepping with a REP Band</b>	1x60ft Level 3	1x60ft Level 3	1x60ft Level 3	1x60ft Level 3	
<b>Rocker Board: Frontal and Sagittal Planes</b>	2x1 minute each	2x1 minute each	2x1 minute each		
<b>NuStep</b>	1x6 minutes, Level 4	1x6 minutes, Level 4	1x5 minutes, Level 4	1x5 minutes, Level 4	
<b>Hurdles: Forward and Lateral Stepping</b>	2x5 1” hurdles each way	2x5 1” hurdles each way with 3# ankle weights	2x5 1” hurdles each way with 3# ankle weights	2x5 1” hurdles each way with 3# ankle weights	
<b>Tandem Stance on Firm Surface</b>		2x30 seconds, attempts	2x30 seconds, attempts	2x30 seconds, attempts	2x30 seconds, attempts
<b>Staggered Stance on Foampad</b>	1x2 minutes total with Trunk Rotations	1x2 minutes total with Trunk Rotations/Cross Body Reach		1x2 minutes total with Trunk Rotations/Cross Body Reach	
	<b>Rx Day 11</b>	<b>Rx Day 12</b>	<b>Rx Day 13</b>	<b>Rx Day 14</b>	<b>Rx Day 15</b>
<b>Calf Raises</b>	1x15	1x15	1x15 with 3# ankle weights	1x15 with 3# ankle weights	1x20 with 3# ankle weights
<b>Sit to Stand</b>	1x5 with UE support.	1x5 with UE support.	1x5 with UE support.	1x6 with UE support.	1x6 with UE support.
<b>Standing Hip Abduction</b>	1x15 with 3# ankle weights	1x15 with 3# ankle weights	1x15 with 4# ankle weights	1x15 with 4# ankle weights	
<b>Standing Hip Extension</b>	1x15 with 3# ankle weights	1x15 with 3# ankle weights	1x15 with 4# ankle weights	1x15 with 4# ankle weights	
<b>Calf Stretch &amp; Seated Hamstring Stretch</b>	2 x 30 seconds each	2 x 30 seconds each	2 x 30 seconds each	2 x 30 seconds each.	



<b>Lateral Stepping with a REP Band</b>		2x50ft Level 3	2x50ft Level 3	2x50ft Level 3	2x60ft Level 3
<b>Rocker Board: Frontal and Sagittal Planes</b>	2x1 minute each	2x1 minute each	2x1 minute each	2 x 1 minute each.	2 x 75 seconds each.
<b>NuStep</b>	1x5 min Level 5	1x5 min Level 5	1x5 min Level 5	1x6 min Level 5	1x6 min Level 5
<b>Hurdles: Forward and Lateral Stepping</b>	3x5 over 1” hurdles	3x5 over 1” hurdles	3x5 over 4” hurdles	3x5 over 4” hurdles	3x5 over 4” hurdles
<b>Tandem Stance on Firm Surface</b>	2 x 30 seconds each	2 x 30 seconds each	2 x 30 seconds each	2 x 30 seconds each	2 x 30 seconds each
<b>Staggered Stance on Foampad</b>	2 x 1 minute each with cross body reaching.	2 x 1 minute each with cross body reaching.	2 x 1 minute each with cross body reaching.	2 x 1 minute each with cross body reaching.	2 x 1 minute each with cross body reaching.
	<b>Rx Day 16</b>	<b>Rx Day 17</b>	<b>Rx Day 18</b>	<b>Discharge</b>	
<b>Calf Raises</b>	1x20 with 3# ankle weights	1x20 with 3# ankle weights	1x20 with 3# ankle weights		
<b>Sit to Stand</b>	2x5 with UE support.	2x5 with UE support.	2x5 with UE support.		
<b>Standing Hip Abduction</b>					
<b>Standing Hip Extension</b>					
<b>Calf Stretch &amp; Seated Hamstring Stretch</b>	2 x 30 seconds each	2 x 30 seconds each	2 x 30 seconds each		
<b>Lateral Stepping with a REP Band</b>	2x60ft Level 3	2x60ft Level 3			

<b>Rocker Board: Frontal and Sagittal Planes</b>	2x1 minute each	2x1 minute each		
<b>NuStep</b>	1x6 min Level 5	1x6 min Level 5	1x6 min Level 5	
<b>Hurdles: Forward and Lateral Stepping</b>	3x5 over 4” hurdles	3x5 over 4” hurdles	3x5 over 4” hurdles	
<b>Tandem Stance on Firm Surface</b>	2 x 30 seconds each	2 x 30 seconds each		
<b>Staggered Stance on Foampad</b>	2 x 1 minute each with cross body reaching.	2 x 1 minute each with cross body reaching.	2 x 1 minute each with cross body reaching.	

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428

429 **CARE Checklist**

430 *Final Parts One & Two, PTH708:* Completed for the final submission to document the locations

431 of key case report components.

<b>CARE Content Area</b>	Page
<b>1. Title</b> – The area of focus and “case report” should appear in the title	1
<b>2. Key Words</b> – Two to five key words that identify topics in this case report	1
<b>3. Abstract</b> – (structure or unstructured)	2-3

<ul style="list-style-type: none"> <li>a. Introduction – What is unique and why is it important?</li> <li>b. The patient’s main concerns and important clinical findings.</li> <li>c. The main diagnoses, interventions, and outcomes.</li> <li>d. Conclusion—What are one or more “take-away” lessons?</li> </ul>	
<p><b>4. Introduction</b> – Briefly summarize why this case is unique with medical literature references.</p>	3-4
<p><b>5. Patient Information</b></p> <ul style="list-style-type: none"> <li>a. De-identified demographic and other patient information.</li> <li>b. Main concerns and symptoms of the patient.</li> <li>c. Medical, family, and psychosocial history including genetic information.</li> <li>d. Relevant past interventions and their outcomes.</li> </ul>	5-6
<p><b>6. Clinical Findings</b> – Relevant physical examination (PE) and other clinical findings</p>	6-9 22-24
<p><b>7. Timeline</b> – Relevant data from this episode of care organized as a timeline (figure or table).</p>	14
<p><b>8. Diagnostic Assessment</b></p> <ul style="list-style-type: none"> <li>a. Diagnostic methods (PE, laboratory testing, imaging,</li> </ul>	8-9 22-24

<p>surveys).</p> <ul style="list-style-type: none"> <li>b. Diagnostic challenges.</li> <li>c. Diagnostic reasoning including differential diagnosis.</li> <li>d. Prognostic characteristics when applicable.</li> </ul>	
<p><b>9. Therapeutic Intervention</b></p> <ul style="list-style-type: none"> <li>a. Types of intervention (pharmacologic, surgical, preventive).</li> <li>b. Administration of intervention (dosage, strength, duration).</li> <li>c. Changes in the interventions with explanations.</li> </ul>	<p>9-12. 24-28</p>
<p><b>10. Follow-up and Outcomes</b></p> <ul style="list-style-type: none"> <li>a. Clinician and patient-assessed outcomes when appropriate.</li> <li>b. Important follow-up diagnostic and other test results.</li> <li>c. Intervention adherence and tolerability (how was this assessed)?</li> <li>d. Adverse and unanticipated events.</li> </ul>	<p>9. 15</p>
<p><b>11. Discussion</b></p> <ul style="list-style-type: none"> <li>a. Strengths and limitations in your approach to this case.</li> <li>b. Discussion of the relevant medical literature.</li> <li>c. The rationale for your conclusions.</li> </ul>	<p>16-17</p>

432

d. The primary “take-away” lessons from this case report.	
<b>12. Patient Perspective</b> – The patient can share their perspective on their case.	6
<b>13. Informed Consent</b> – The patient should give informed consent.	6

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