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Strength And Balance Training For A 29-Year-Old Female Who Sustained A Multifocal Stroke: A Case Report

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University of New England
Department of Physical Therapy
PTH 608/708: Case Report Template

Name: Britney Simonton

Title: Strength and balance training for a 29-year-old female who sustained a multifocal stroke: A case report.

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Strength and Balance Training for a 29-Year-Old Female Who Sustained a Multifocal Stroke: A Case Report.

Britney Simonton

Doctor of Physical Therapy Student

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The patient signed a consent form allowing for use of medical information and her picture taken for use of this case report. She was informed on the school’s policies regarding the Health Insurance Portability and Accountability Act.

The author acknowledges Kirsten Buchanan PhD, PT, ATC for the guidance and editing of this case report, Bryan Woo DPT, OCS for the supervision of the case report, and the patient for willingly participating in this case report.

62

63 **ABSTRACT**

64

65 **Background and Purpose:** While balance and strengthening are standard interventions for older
66 patients who have sustained a stroke, there is very limited research on the most effective physical
67 therapy rehabilitation for a young female who recently suffered a stroke. Therefore, the purpose
68 of this case report was to investigate a comprehensive physical therapy program that included
69 balance and strength training for a young female who recently sustained a multifocal stroke.

70 **Case description:** The patient was a 29-year-old female who sustained a multifocal stroke in her
71 left parietal, left frontal, and bilateral occipital lobes. She presented with right lower extremity
72 weakness and numbness, and poor balance. Her plan of care included patient education, home
73 exercise program, LE strengthening, and balance training. Outcome measures included Lower
74 Extremity Functional Scale (LEFS), manual muscle testing (MMT), single limb stance, and
75 dermatome sensitivity testing.

76 **Outcomes:** Improvements were noted in her progress note during her 5th week. Lower Extremity
77 Functional Scale improved (31/80 to 50/80). General hip strength improved (3+/5 to 4/5). Knee
78 extension improved (4-/5 to 4+/5). Single limb stance on right foot improved from unable to
79 perform to 30 seconds. Dermatome sensation improved at L3 from complete numbness to normal
80 sensation.

81 **Discussion:** A comprehensive physical therapy program that included balance and strength
82 training was beneficial for a 29-year-old patient who had sustained a multifocal stroke. Future
83 research should investigate a younger cohort of patients who have sustained a stroke and the best
84 treatment option available.

85 Manuscript Word Count: 3356

86

87 **BACKGROUND and PURPOSE**

88 In the United States, approximately 795,000 people suffer a stroke annually.¹ A stroke
89 occurs when there is a decreased blood supply to the brain which deprives it from oxygen and
90 nutrients. Typically, this is caused by a blood clot or from a burst blood vessel. Stroke is the
91 leading cause of long term disability in the United States.¹

92 Those who survive a stroke present with certain impairments depending on the location
93 of the infarct. Common symptoms reported by patients who sustained a frontal lobe stroke may
94 include weakness on one side of the body, behavioral changes, memory problems, and trouble
95 with self-care. An infarct in the parietal lobe may cause symptoms of sensation loss on one side
96 of the body, impairments in spatial perception, and problems with motor tasks. A stroke in the
97 occipital lobes can cause partial or full vision loss. Impairments often affect balance and gait
98 which can make it difficult to return to daily activities. Nearly three-quarters of all strokes occur
99 in individuals older than the age of 65.¹ After each decade following the age of 55, the risk of
100 experiencing a stroke nearly doubles.¹ Common risk factors for a stroke include high blood
101 pressure, tobacco use, high cholesterol, diabetes, obesity, and physical inactivity. Common risk
102 factors that are uncontrollable include increasing age, gender, heredity, and prior stroke. It is
103 uncommon for a young adult with a normal body mass index (BMI) and no family history to
104 have a stroke.

105 Physical therapy, especially balance and gait training, have been shown to be beneficial
106 when treating patients who have sustained a stroke. A randomized controlled trial by Ordahan,
107 Karahan, and Basaran demonstrated that balance training had a positive impact on balance and
108 postural control of a person who had sustained a stroke.² The study discussed that improvements
109 in motor function were the result of spontaneous recovery, visual feedback, and re-education of

110 the brain. The study demonstrated that visual biofeedback was effective during static balance by
111 increasing activity of the neuromuscular effector system.²

112 Balance dysfunction in stroke survivors is common and have an impact on their
113 functional independence. In addition to balance impairment, gait impairments also increase the
114 risk of falling. A cross-sectional study done by Obembe, Olaogun, and Adedoyin has shown a
115 correlation between balance performance and gait parameters for those at risk for falling after
116 they suffered a stroke.³ The study had seventy stroke survivors who participated with a mean age
117 of 53.5 ± 10.4 years. It demonstrated that stroke survivors with higher cadence and higher gait
118 speeds had better balance self-efficacy which in turn reduced their risk of falling.³ Therefore,
119 they concluded that a rehabilitation program for a stroke survivor should include balance training
120 due to balance being an important factor of gait to reduce the risk of falls.

121 Strength training has been shown to be beneficial for those who have experienced a
122 stroke. The systematic review of 21 studies concluded that strength training after a stroke had a
123 small, positive effect for improving muscle strength and activity.⁴ The strength training
124 interventions consisted of EMG-biofeedback, electrical stimulation, muscle re-education, and
125 progressive resistance training. The studies in the review recommended performing strength
126 training interventions within six months of the stroke to be most beneficial.⁴ The review
127 concluded that the interventions were effective, worthwhile, and not harmful.⁴

128 While multiple studies have investigated rehabilitation on adults over the age of 65 who
129 recently sustained a stroke, there is only a small amount of research on the best treatment plan
130 for a young adult under the age of 30 who has sustained a stroke. Some evidence has shown the
131 benefits of strength and balance training for adults over the age of 30, however the evidence for
132 young adults is lacking. Therefore, the purpose of this case report was to investigate a

133 comprehensive physical therapy program, that included balance and strength training, in a 29-
134 year old patient who had recently sustained a stroke.

135
136 **CASE DESCRIPTION**
137

138 **Patient History and Systems Review**

139 The patient consented to participating in this case report. The patient was a 29-year-old
140 female who presented to outpatient physical therapy four weeks following a stroke. Two weeks
141 prior to her diagnosis, the patient reported having a constant migraine for which she went to the
142 emergency room at the local hospital five times. Two weeks after her initial visit to the hospital,
143 the patient returned to the emergency room with sudden onset of blurry vision, right anterior leg
144 and foot hemiparesis and hemiplegia. A computed tomography (CT) scan was performed which
145 showed multiple infarcts which involved the left parietal, frontal, and bilateral occipital lobes.

146 The patient was a young, white female with no family history of a stroke, no high blood
147 pressure, normal BMI, and was a non-smoker. She worked as a medical assistant for an
148 outpatient physician office. She lived in a two-story home with her supportive husband and two
149 young children.

150 After the stroke, she remained at the hospital and received inpatient rehab for two weeks,
151 and acute rehab for one week. She presented to her initial PT visit walking with a single point
152 cane, had a lateral shift with increase weight bearing on her left leg, decreased toe-off through
153 the right foot, unsteadiness in single leg stance, and climbed stairs with a step-to gait pattern. Her
154 primary complaint was generalized weakness and sensation loss in her right leg and foot,
155 moderate headaches, blurry vision, and dizziness with quick movements. She was unable to walk
156 longer than 30 minutes without needing to rest. Additionally, she was unable to perform duties at
157 work due to the fast-paced environment, and unable to climb stairs without assistance from the

158 railing and her cane. A list of her medications are listed below in Table 3. Her goals included
159 improving her strength and balance so she could return to work and help her husband take care
160 of their children and home. Refer to Table 2 for the systems review.

161

162 **Clinical Impression 1**

163 Due to the patient's CT scan and presentation, it was suspected that she had acute infarcts
164 involving the parietal, and bilateral occipital lobes. The CT scan performed on her cervical spine
165 showed moderate multilevel stenosis of the right distal vertebral artery which resulted in her
166 multiple infarcts. Her deficits included blurry vision, generalized motor weakness and sensation
167 loss in her lower extremities (LE), decreased proprioception, decreased activity tolerance, and
168 impaired balance. It was hypothesized she had a stroke which involved her parietal and occipital
169 lobes due to the patient's symptoms. Potential differential diagnosis discussed included multiple
170 sclerosis. The plan for exam based on existing data included Lower Extremity Functional Scale
171 (LEFS), manual muscle testing, range of motion, gait analysis, dermatome testing, testing of
172 deep tendon reflexes (DTR), Modified Ashworth Scale, upper quarter screening, and balance
173 testing. Her functional limitations resulted in her inability to walk long distances without an
174 assistive device, participate in household chores, drive, and return to work. Physical therapy
175 focused on lower extremity (LE) strengthening and balance, and addition of gait training and
176 postural cueing to achieve her goals of returning to work and household responsibilities.

177 The patient was a good candidate for a case report due to the rarity of her condition. It is
178 unlikely for someone of her age, gender, with no family history, low blood pressure, no history
179 of smoking, normal BMI, and activity level to have experienced multiple strokes. Also, she was
180 very motivated and willing to participate in physical therapy.

181

182 **Examination – Tests and Measures**

183 A LEFS was filled out by the patient to evaluate her LE impairment. While content and
184 face validity has not been established, it has excellent test-retest and interrater reliability.⁵ In the
185 rehabilitation of patients with subacute stroke, the LEFS has been shown to be a clinically
186 efficient outcome measure.⁵

187 An observational gait analysis (OGA) at initial evaluation was performed. An OGA has
188 moderate interrater reliability due to the variability of observable items in a gait analysis.⁶
189 Lateral flexion of the trunk, arm swing, and knee extension in the late swing phase are
190 considered easy to observe. Pelvis rotation and plantar flexion at the ankle in the late stance
191 phase are considered more difficult to observe to the naked eye. According to the study by
192 Brunnekreef, both experienced and inexperienced raters have good reliability.⁶

193 Gross active range of motion and gross manual muscle testing was assessed. Manual
194 muscle testing is a standardized assessment to measure muscle strength. While content validity
195 has not been established, it has been shown to have excellent test-retest reliability.⁷ Active range
196 of motion testing using a manual goniometer has shown high test-retest reliability in unskilled
197 and skilled examiners.⁸ A balance assessment consisting of sitting balance, narrow base of
198 support (NBOS), tandem stance, and single leg stance was performed to assess any factors that
199 affected her function and her risk of falling. A timed standing balance test, measured by a
200 stopwatch, has been shown to have absolute and relative reliability, along with concurrent
201 validity compared to other timed balance measures.⁹

202 Testing of deep tendon reflexes (DTRs) are part of a neurological exam and were
203 assessed to determine if there were any impairments within her two-neuron reflex arc.
204 Dermatome sensation was assessed as part of the neurological exam to determine any sensation
205 loss at a specific spinal level. A Modified Ashworth Scale was used to measure spasticity at a

206 joint due to spasticity being a common symptom for someone who has experienced a stroke. It
207 has been shown to have adequate intra-rater reliability in the lower extremities of 73% for
208 patients who had sustained a stroke.¹⁰ An image describing the instructions and scoring of the
209 Modified Ashworth Scale can be found in the appendices. All results from the examination can
210 be found in Table 7.

211

212 **Clinical Impression 2**

213 Based on the examination data, the original diagnosis of a cerebrovascular accident
214 (CVA) was confirmed by MRI results. The MRI confirmed diagnosis of acute infarcts of left
215 frontal, parietal, and bilateral occipital lobes.

216 At initial evaluation, she demonstrated poor posture compensation for right sided lower
217 extremity weakness, which aligned with her physical therapy diagnosis of hemiplegia and
218 hemiparesis following left cerebral infarction affecting right dominant side (ICD-10 code
219 I69.351). The patient continued with skilled physical therapy because she remained motivated
220 and demonstrated improvements quickly in the weeks following outpatient physical therapy.

221 The patient was young, active, motivated and had a strong support system. Her barriers to
222 recovery consisted of unilateral lower extremity paresis, sensory impairments, and blurred vision
223 which resulted in her inability to drive to the clinic. Despite these barriers, her support team and
224 motivation provided for a good prognosis.

225 The treatment plan for this patient was to be seen twice a week for five weeks, for one
226 hour treatment sessions. Her plan of care consisted of progressive exercises to improve lower
227 extremity strength, balance and proprioception training, and cueing for postural control. The
228 goal was to perform a re-evaluation at week four to measure improvements in manual muscle
229 testing, LEFS, tandem stance, and single leg stance. She planned on consulting with an

230 optometrist about her blurry vision. The short and long term goals agreed upon by the therapist
231 and the patient are listed in Table 1.

232

233 **Intervention**

234 **Coordination, Communication, and Documentation**

235 After her initial evaluation, a plan of care was established to focus on lower extremity
236 strengthening and balance training. The initial evaluation was faxed to her neurologist to keep
237 him informed of her treatment plan. Communication between other physical therapists and
238 physical therapist assistants were maintained to provide the same care to achieve short and long
239 term goals. A printed home exercise program was provided to the patient with pictures and
240 written instructions. All documentation was completed on electronic medical records (EMR)
241 system for easy access from other therapists, insurance companies, and physicians.

242 **Patient/Client Related Instructions**

243 During the initial evaluation, the patient was informed of the plan of care and expected
244 outcomes by the time of discharge. She was instructed to perform her independent home exercise
245 program twice a day for each day of the week. She was instructed to use her cane while walking
246 on uneven surfaces or for long distances. She was educated on the importance of being aware of
247 her posture with activity to reduce compensation and prevent additional injuries.

248 **Interventions**

249 Outpatient physical therapy included five 1-hour sessions over a 5-week period. During
250 the first two weeks, the patient attended physical therapy twice a week. A progress report was
251 done on her fifth visit during week five. The focus of the interventions were to improve strength,
252 balance, and postural control.

253 Interventions performed at initial evaluation included exercises to strengthen glute
254 musculature. According to Hamstra-Wright and Bliven, the gluteus medius muscle plays an
255 important role in stabilizing the pelvis and controlling femoral adduction and internal rotation
256 during functional activity.¹¹ Also, gluteus medius strengthening has been shown to improve
257 lower extremity kinematics for the prevention of dysfunction and injury.¹¹ All exercises were
258 performed on the table due to the patient feeling unsteady while ambulating without a cane.
259 These exercises included sidelying (s/l) clams with resistance and s/l hip abduction. She
260 presented with a left lateral trunk lean due to weight bearing more on the unaffected leg. Manual
261 therapy was provided to correct the lateral trunk lean. According to McKenzie, 90% of people
262 respond rapidly to manual correction, and it has been shown to result in superior outcomes
263 compared to a control treatment of nonspecific massage and general back care advice.¹² She was
264 educated on an exercise how to independently self-correct her lateral lean at home. A picture of
265 the self-correction exercise can be found in Figure 3.

266 During the second visit, the patient presented with improved posture with decreased
267 lateral trunk lean, and could ambulate without an assistive device. The second visit had
268 additional interventions with an emphasis on balance training. According to Ordahan, balance
269 training exercises have shown an improvement in postural control and functional activities.² The
270 balance training exercises included step ups onto a 4-inch Original Step (Step Fitness &
271 Recreation, Inc., Marietta, GA) and bilateral heel raises. A study by Rozzi and Lephart looked at
272 the effects of a 4-week single-leg balance training program. They concluded a single-leg balance
273 program improved joint proprioception and single-leg standing ability.¹³ These exercises
274 included agility cone taps (Power Systems, Knoxville, TN) with single leg stance (SLS) on right
275 leg, SLS with trunk leans, tandem stance, and SLS on the Airex foam (Magister Corp,
276 Chattanooga, TN). The third session the patient demonstrated no lateral trunk lean and the self-

277 correction exercise was discontinued. She continued with the procedural interventions including
278 s/l clams, s/l hip abduction, heel raises, single leg cone taps and trunk leans, SLS on foam, and
279 tandem stance on foam. The repetitions were progressed when the patient demonstrated
280 improved muscle endurance. Some of the procedural interventions can be found in Figures 1-3.
281 The procedural interventions were implemented to improve strength and endurance that would
282 allow her to return to work without any limitations, and to prevent falls while ambulating on
283 uneven ground or long distances in the community. The patient did not require stretching
284 exercises due to her normal range of motion at the hip, knee, and ankle. Parameters for each
285 intervention can be found in Table 4. The patient was compliant with her independent home
286 exercise program 4-5 days a week which can be found in Table 5.

287

288 **OUTCOME**

289 PT interventions primarily focused on improving the patient's functional mobility
290 through balance training, postural control, and lower extremity strengthening. After five sessions
291 over five weeks, the therapist observed improvements in ambulation and postural symmetry.
292 Initially, an OGA revealed slow cadence, a lateral shift to the right, decreased toe-off through her
293 right foot, and use of a single-point cane in her left hand. The patient reported a step-to gait
294 pattern and holding onto the railing with one hand while ascending and descending stairs. During
295 her re-evaluation, the patient showed no lateral shift, increased cadence, and did not use an
296 assistive device. She improved her single leg stance time by reaching max time of thirty seconds
297 compared to 0 seconds in the beginning. Tandem stance improved from three seconds to
298 reaching max of 30 seconds with no loss of balance. She reported she could walk a mile without
299 needing to rest, compared to half a mile at initial evaluation.

300 Manual muscle testing of upper extremity and left lower extremity were within normal
301 limits. Her general right lower extremity strength improved one full manual muscle test grade.
302 Her improved strength enabled her to ascend and descend stairs reciprocally with one hand on
303 the railing for safety instead of using a step-to gait pattern. Her gross range of motion were
304 within normal limits for all upper and lower extremities. She did not present with any spasticity
305 in her upper or lower extremities. She demonstrated improvement of dermatome L2 sensation
306 from complete sensation loss to normal sensation. Additionally, dermatome L3 improved from
307 mild sensation loss to normal sensation. She continued to show mild sensation loss at L4-S2 with
308 no improvements. While testing her deep tendon reflexes, hyperreflexia was noted as 3+ for her
309 right patellar tendon and achilles tendon. At re-evaluation, her LE reflexes returned to a normal
310 grade of 2+. She continued to have blurry vision which resulted in her inability to drive. She
311 intended to return to work as a medical assistant in one month. Her LEFS score improved from
312 31/80 to 50/80. Although LEFS does not have a MCID specific to a stroke, it has demonstrated a
313 MCID of 9 or better to be statistically significant in other diagnosis.⁵ Results of her test and
314 measures taken at week five can be seen in Table 6, and status of short and long-term goals can
315 be seen in Table 1.

316

317 **DISCUSSION**

318 The goal of this case report was to investigate a strength and balance training program for
319 a young adult who recently sustained a multifocal stroke. The rehabilitation program was created
320 based on research that has found strength and balance programs to be beneficial for older adults
321 who have sustained a stroke. The study performed by Ordahan, et al demonstrated a significant
322 improvement in balance for elderly patients who have sustained a stroke after performing
323 balance training for 30 sessions in 6 weeks.² The patients who participated in the randomized

324 control trial had a mean age of 57-years-old. The patient displayed improvements during her re-
325 evaluation on her fifth visit during week five. She demonstrated improvements in her strength,
326 endurance, gait speed and quality, postural control, and balance. These results suggested that
327 lower extremity strength and balance training may be beneficial to improve functional limitations
328 in a young stroke survivor with fewer treatment sessions. Positive factors that may have
329 contributed to her positive outcome include her age, positive support at home, general good
330 health, and the patient's motivation. Although transportation issues initially were thought as a
331 barrier, her improvements at re-evaluation suggested that the minimal number of treatment
332 sessions did not hinder her recovery. It is unclear if the patient improved from the physical
333 therapy interventions, or if she improved on her own with time.

334 The reported outcome measures were consistent with the provided evidence which stated
335 the inclusion of a strength and balance training program for patients who experienced a
336 multifocal stroke to be beneficial to return to their functional activities. Although this program
337 has been shown to be beneficial for both older and younger populations, it may suggest that
338 younger populations may yield similar functional outcomes with fewer visits compared to older
339 adults. Further research is warranted to maximize on the effects of strength and balance training
340 for young adults. Additional research may investigate if young adults who sustained a multifocal
341 stroke would benefit from a strength and balance training program with limited physical therapy
342 visits.

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348 **REFERENCES**

- 349 1. The Internet Stroke Center. An independent web resource for information about stroke
350 care and research. <http://www.strokecenter.org/patients/about-stroke/stroke-statistics/>.
351 Published 2002. Accessed July 13, 2017.
- 352 2. Ordahan B, Karahan AY, Basaran A, et al. Impact of exercises administered to stroke
353 patients with balance trainer on rehabilitation results: a randomized controlled
354 study. *Hippokratia*. 2015;19(2):125-130.
- 355 3. Obembe AO, Olaogun MO, Adedoyin R. Gait and balance performance of stroke
356 survivors in south-western Nigeria – A Cross-Sectional Study. *The Pan African Medical*
357 *Journal*. 2014;17(Suppl 1):6. Doi:10.11694/pamj.supp.2014.17.1.3001.
- 358 4. Ada L, Dorsch S, Canning CG. Strengthening interventions increase strength and
359 improve activity after stroke: a systematic review. *The Australian Journal of*
360 *Physiotherapy*. 2006;52(4):241-248. <http://www.ncbi.nlm.nih.gov/pubmed/17132118>.
361 Accessed July 13, 2017.
- 362 5. Weinhold J, Basch B, Good L. Rehab Measures: Lower Extremity Functional Scale.
363 Rehabilitation Measures Database.
364 <http://www.rehabmeasures.org/Lists/RehabMeasures/PrintView.aspx?ID=1113>.
365 Accessed July 2, 2017.
- 366 6. Brunnekreef JJ, van Uden CJ, van Moorsel S, Kooloos JG. Reliability of videotaped
367 observational gait analysis in patients with orthopedic impairments. *BMC*
368 *Musculoskeletal Disorders*. 2005;6:17. Doi:10.1186/1471-2474-6-17.
- 369 7. Romney W, Weisbach C. Rehabilitation measures database. Rehab Measures Web
370 site. <http://www.rehabmeasures.org/Lists/RehabMeasures/PrintView.aspx?ID=1033>.
371 Accessed September 23, 2017.

- 372 8. Kim S, Kim K. Test-retest reliability of an active range of motion test for the shoulder
373 and hip joints by unskilled examiners using a manual goniometer. *Journal of Physical*
374 *Therapy Science*. 2016;28(3):722-724. doi:10.1589/jpts.28.722.
- 375 9. Aranha VP, Samuel AJ, Saxena S. Reliability and sensitivity to change of the timed
376 standing balance test in children with down syndrome. *Journal of Neurosciences in Rural*
377 *Practice*. 2016;7(1):77-82. Doi:10.4103/0976-3147.165412.
- 378 10. Palma P, Newman C. Rehab Measures: Ashworth Scale/ Modified Ashworth Scale.
379 Rehabilitation Measures Database.
380 <http://www.rehabmeasures.org/Lists/RehabMeasures/PrintView.aspx?ID=902>. Accessed
381 July 1, 2017.
- 382 11. Hamstra-Wright KL, Bliven KH. Effective Exercises for Targeting the Gluteus Medius,
383 *Journal of Sport Rehabilitation*. 2012, 21(3):296-300. Doi:10.1123/jsr.21.3.296
- 384 12. Laslett M. Manual correction of an acute lumbar lateral shift: Maintenance of correction
385 and rehabilitation: A Case Report with Video. *The Journal of Manual & Manipulative*
386 *Therapy*. 2009;17(2):78-85.
- 387 13. Rozzi SL, Lephart SM, Sterner R, Kuligowski L. Balance training for persons with
388 functionally unstable ankles. *The Journal of Orthopaedic and Sports Physical Therapy*.
389 1999;29(8):478-486. <http://www-ncbi-nlm-nih-gov.une.idm.oclc.org/pubmed/10444738>.
390 Doi: 10.2519/jospt.1999.29.8.478.
- 391 14. Bohannon R, Smith M. Interrater reliability of a modified Ashworth scale of muscle
392 spasticity. *Physical Therapy* 1987;67(2):206.
- 393 15. Brinkley J, Stafford P, Lott S, Ridle D, & The North American Orthopedic Rehabilitation
394 Research Network, The Lower Extremity Functional Scale: Scale development,
395 measurement properties, and clinical application, *Physical Therapy*,1999,79,4371-383.

396 Kim S-G, Kim E-K. Test-retest reliability of an active range of motion test for the shoulder and
397 hip joints by unskilled examiners using a manual goniometer. *Journal of Physical Therapy*
398 *Science*. 2016;28(3):722-724. doi:10.1589/jpts.28.722.

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405 **TABLES and FIGURES**

406 Table 1. Goals

407

Time frame	Goal	At discharge
Short Term: 3 weeks	Patient will receive a score of hip abduction strength of 4-/5 to walk longer than 40 minutes without needing to take a rest while shopping at the grocery store	Achieved
	Patient will improve single leg stance on the right leg to 20 seconds to ambulate without an assistive device	Achieved
	Patient will be able to perform tandem stance for 20 seconds without loss of balance to ambulation with no unsteadiness	Achieved
Long Term: 6 weeks	Patient will receive a score of 70/80 on her LEFS to be able to work with no limitations	Not achieved
	Patient will improve knee extension strength to 4+/5 to ascend and descend stairs reciprocally to get to her bedroom	Achieved
	Patient will improve R SLS to 30 seconds on stable ground to reduce risk of falling	Achieved

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Table 2. Systems Review at initial evaluation

Systems Review	
Cardiovascular/Pulmonary	Impaired: decreased endurance
Musculoskeletal	Impaired: impaired gross strength in R LE; impaired gait with lateral shift with increase WB on L leg and decreased R toe-off
Neuromuscular	Impaired: decreased balance in R SLS; sensation loss at L2, impaired sensation L3-S2; impaired proprioception, abnormal reflexes 3+ (L3-4, S1-2)
Integumentary	Not impaired
Communication	Not impaired
Affect, Cognition, Language, Learning Style	Not impaired

413

414 Table 3. Medications at initial evaluation

Medication	Usage
Ranitidine	Prevent stomach ulcers when they are a side effect of some medicines
Aspirin	For preventing blood clots
Plavix	Prevents blood clots after a recent stroke
Amitriptyline	Used to treat symptoms of depression

415

416

417 Table 4. Procedural Interventions

Intervention	Rx Day 1	Rx Day 2	Rx Day 3	Rx Day 4
s/l clams	Lv 2 TB 2 x10 reps	Lv 2 TB 2x10 reps	Lv 2 TB 2x10 reps	Lv 2 TB 3x10 reps
s/l hip abduction	2 x10 reps	2x10 reps	2x10 reps	2x10 reps
Bridges	2 x 10 reps	2x10 reps	2x10 reps	3x10 reps
Lateral shift correction	1 x 10 reps	1x10 reps		
NBOS		Foam EC 2 x 30 sec	Foam EC 2 x 30 sec	Foam EC 2 x 30 sec
SLS		Foam EO 2 x 30 sec	Foam with ball toss	BOSU with ball toss

			2 x 10 tosses	2 x 10 tosses
Tandem Stance		Foam EO 2 x 30 sec	Foam EO 2 x 30 sec	Foam EO 2 x 30 sec
SLS 4-way cone taps		1 x 10 each direction	1 x 10 each direction	1 x 10 each direction
SLS 4-way trunk leans		1 x 5 each direction	1 x 5 each direction	1 x 5 each direction
Standing marches in mirror		1 x 2 minutes	1 x 2 minutes	
Step ups		6-inch step 2 x 10	6-inch step 2 x 10	6-inch step 2 x 10
Squats		2 x 10	2 x 10	On BOSU 2 x 10
Heel Raises		2 x 10	2 x 10	2 x 10
Recumbent bike			5 minutes	5 minutes

418 s/l (sideline). Clams (clamshells). Lv (level). X (times). reps (repetitions). TB (theraband). NBOS (narrow base of
 419 support). EC (eyes closed). EO (eyes open). Sec (seconds).
 420

421 Table 5. Independent Home Exercise Program.
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Intervention	Rx
s/l clams	Lv 2 2 x 10
s/l hip abduction	2 x 10
Bridges	2 x 10
Heel raises	2 x 10
Squats	2 x 10
Postural correction in front of mirror	1 x 10
Standing marches in front of mirror	1 x 2 minutes

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432 Table 6. Examination – Test and Measures.

Tests & Measures	Initial Evaluation Results	Re-evaluation Results
Lower Extremity Functional Scale	31/80 – lower scores indicate greater disability	50/80
Gait	Lateral shift with increase weight bearing on L leg, decreased toe-off of R foot, use of single-point cane in L hand	Normal gait pattern with no use of assistive device
Stair Climbing	Step-to gait pattern with use of railing for assistance	Reciprocal gait pattern with one hand on railing
Dermatomes	R LE: complete sensation loss at L2, mild sensation loss at L3, L4, L5, S1 and S2 L LE: normal	R LE: normal sensation at L2-L3; mild sensation loss at L4-S2 L LE: normal
Endurance	Walking without rest: 0.5 miles	Walking without rest: 1 mile
Deep Tendon Reflexes	R LE: hyper reflexive at patellar tendon and Achilles tendon L LE: normal	Normal
Modified Ashworth Scale	Grade: 0 - Normal	Grade: 0 - Normal
Upper quarter screening	Normal	Normal
Balance Screening	Sitting balance: normal Standing balance: normal NBOS EO: normal NBOS EC: normal Tandem: 3 seconds SLS on L: normal SLS on R: unable	Sitting balance: normal Standing balance: normal NBOS EO: normal NBOS EC: normal Tandem: 30 seconds SLS on L: normal SLS on R: 30 seconds
Foot and Ankle Strength Testing	R Dorsiflexion: 4/5 L Dorsiflexion: 5/5 R Plantarflexion: 4/5 L Plantarflexion: 5/5	R Dorsiflexion: 5/5 L Dorsiflexion: 5/5 R Plantarflexion: 5/5 L Plantarflexion: 5/5
Hip Strength Testing	R Hip Abduction: 3+/5 L Hip Abduction: 4/5 R Gluteus Maximus: 3+/5 L Gluteus Maximus: 4/5 R Hip Flexion: 4-/5 L Hip Flexion: 4+/5	R Hip Abduction: 4/5 L Hip Abduction: 4/5 R Gluteus Maximus: 4/5 L Gluteus Maximus: 4/5 R Hip Flexion: 4/5 L Hip Flexion: 4+/5
Knee Strength Testing	R Knee Extension: 4-/5 L Knee Extension: 5/5 R Knee Flexion: 4-/5 L Knee Flexion: 4+/5	R Knee Extension: 5/5 L Knee Extension: 5/5 R Knee Flexion: 4+/5 L Knee Flexion: 4+/5

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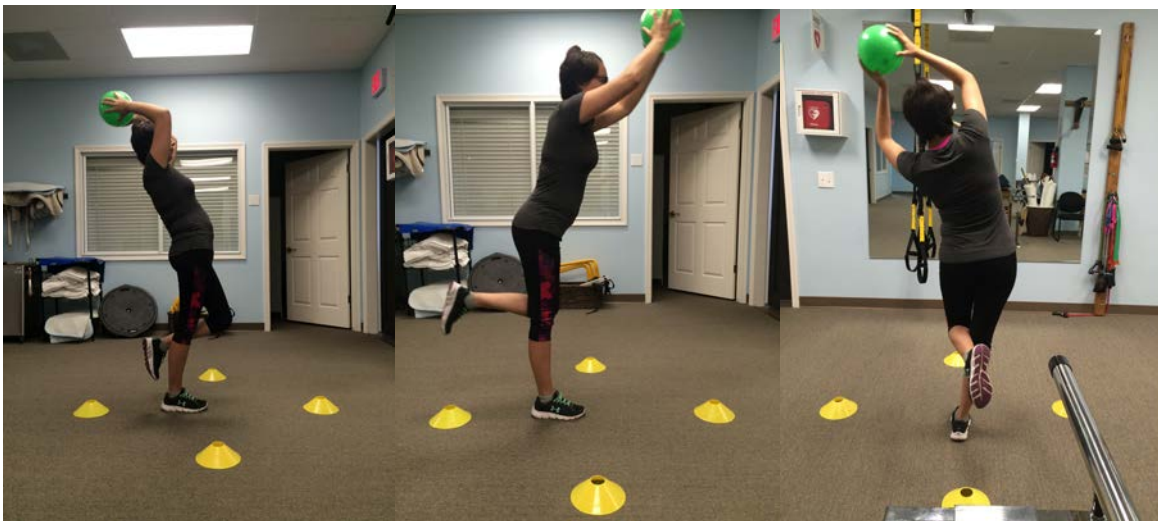
442 **Figure 1.** Single leg stance with cone taps.
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445 Stand in the center of four cones placed in front, back, and each side of the patient. Balance on the right
446 leg with slight bend in the knee. With the unaffected leg reach and touch each cone without loss of
447 balance. Repeat 10 times to each cone.
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452 **Figure 2.** Single leg stance with trunk leans.
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455 Balance on right leg with slight bend in the knee while holding a ball or light weight overhead. Slowly
456 lean forward, backward, and to each side without loss of balance. Repeat five times.
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Figure 3. Lateral shift correction.



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Lean right side up against a wall, and with the left hand push against left pelvis towards the wall. Hold stretch for a count of five seconds and repeat ten times.

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486 **APPENDICES**

Modified Ashworth Scale Instructions

General Information (derived Bohannon and Smith, 1987):

- Place the patient in a supine position
- If testing a muscle that primarily flexes a joint, place the joint in a maximally flexed position and move to a position of maximal extension over one second (count "one thousand one")
- If testing a muscle that primarily extends a joint, place the joint in a maximally extended position and move to a position of maximal flexion over one second (count "one thousand one")
- Score based on the classification below

Scoring (taken from Bohannon and Smith, 1987):

- 0 No increase in muscle tone
- 1 Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
- 1+ Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM
- 2 More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
- 3 Considerable increase in muscle tone, passive movement difficult
- 4 Affected part(s) rigid in flexion or extension

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“THE LOWER EXTREMITY FUNCTIONAL SCALE”

Name: _____

Date: _____

We are interested in knowing whether you are having any difficulty at all with the activities listed below because of your lower limb problem for which you are currently seeking attention. Please provide an answer for each activity.

Today, do you, or would you have any difficulty at all with:

	Activities	Extreme Difficulty or Unable to Perform Activity	Quite a Bit of Difficulty	Moderate Difficulty	A Little Bit of Difficulty	No Difficulty
1	Any of your usual work, housework or school activities	0	1	2	3	4
2	Your usual hobbies, recreational or sporting activities	0	1	2	3	4
3	Getting into or out of the bath	0	1	2	3	4
4	Walking between rooms	0	1	2	3	4
5	Putting on your shoes or socks	0	1	2	3	4
6	Squatting	0	1	2	3	4
7	Lifting an object, like a bag of groceries, from the floor	0	1	2	3	4
8	Performing light activities around your home	0	1	2	3	4
9	Performing heavy activities around your home	0	1	2	3	4
10	Getting into or out of a car	0	1	2	3	4
11	Walking 2 blocks	0	1	2	3	4
12	Walking a mile	0	1	2	3	4
13	Going up or down 10 stairs (about 1 flight of stairs)	0	1	2	3	4
14	Standing for 1 hour	0	1	2	3	4
15	Sitting for 1 hour	0	1	2	3	4
16	Running on even ground	0	1	2	3	4
17	Running on uneven ground	0	1	2	3	4
18	Making sharp turns while running fast	0	1	2	3	4
19	Hopping	0	1	2	3	4
20	Rolling over in bed	0	1	2	3	4
	Column Totals:					

Minimum Level of Detectable Change (90% Confidence): 9 points

SCORE: _____/80

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