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12-6-2016

# Use Of Functional Strengthening, Balance Training, And Stretching In The Treatment Of A Patient Following A T11-L5 Spinal Fusion: A Case Report

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## Recommended Citation

Sidloski, Anna, "Use Of Functional Strengthening, Balance Training, And Stretching In The Treatment Of A Patient Following A T11-L5 Spinal Fusion: A Case Report" (2016). *Case Report Papers*. 58.  
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**University of New England**  
**Department of Physical Therapy**  
**PTH 608: Case Report Template**

Name: Anna Sidloski

Abbreviated (Running) Title: Use of Functional Strengthening, Balance Training, and Stretching in an Individual Following A T11-L5 Spinal Fusion

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35                    **Use of Functional Strengthening, Balance Training, and Stretching In The**  
36                    **Treatment Of A Patient Following a T11-L5 Spinal Fusion: A Case Report**

37                    Anna Sidloski

38

39

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44

45                    The patient signed an informed consent form allowing the use of his medical history and  
46 photo/video footage for this case report. He received information on the university's Health

47                    Insurance Portability and Accountability Act (HIPAA) policies.

48

49

50                    The author acknowledges Brian Swanson PT, DSc, OCS, FAAOMPT for assistance with case  
51 report conceptualization and Michael Wezel, DPT, FAAOMPT, for supervising and assisting

52                    with patient management.

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57

58 **ABSTRACT**

59 **Background and Purpose:** Lumbar spinal fusion surgery has been utilized to manage levels of  
60 low back pain and instability.<sup>2</sup> However, pain often persists post-operatively. Evidence supports  
61 the use of Transverse Abdominis recruitment in patients with LBP.<sup>4</sup> Research demonstrates  
62 strengthening the hip musculature may allow for improved outcomes for those who experience  
63 LBP.<sup>6</sup> There is limited research focusing on lower extremity strengthening, flexibility, and  
64 balance training in a patient following a T11-L5 spinal fusion.

65 **Case Description:** The patient was a 68-year-old male presenting to physical therapy eight  
66 weeks' status post T11-L5 spinal fusion with ~45 degrees forward-flexed posture, weak lower  
67 extremity musculature, and restricted muscle lengths. Post operatively, the patient smoked and  
68 did not engage in exercise prior to surgery. Interventions consisted of TA recruitment, lower  
69 extremity/glute strengthening, stretching, and balance training. Outcome measures included  
70 Numeric Pain Rating Scale (NPRS), Oswestry Disability Index (ODI), Dynamic Gait Index  
71 (DGI), and Berg Balance Scale (BBS).

72 **Outcomes:** Results from initial evaluation to discharge: ODI 54% to 36%, NPRS 3-8/10 to 0-  
73 5/10, DGI 16/24 to 16/24, and BBS 43/54 to 43/56, demonstrating improved function and  
74 decreased pain, but similar balance scores.

75 **Discussion:** These interventions may be beneficial in improving functional strength and posture  
76 s/p spinal fusion. Cigarette smoking and lack of previous exercise may have contributed to lack  
77 of large improvements in balance and MMT, and inability for the patient to return to work.  
78 Further research is needed to report upon the outcomes of this approach in managing individuals  
79 with LBP after spinal fusion surgery.

80

81 **BACKGROUND and PURPOSE**

82 Low back pain (LBP) is a prevalent condition, resulting in more lost workdays and  
83 disability claims than any other health condition.<sup>1</sup> Approximately 67%-84% of people living  
84 industrialized countries have or have had episodes of LBP.<sup>1</sup> Because an estimated 40% of  
85 patients with acute LBP demonstrate functional limitations after three months, the importance of  
86 skilled physical therapy services to address these functional limitations cannot be  
87 underestimated.<sup>1</sup>

88 Lumbar spinal fusion surgery has been widely used to manage pain and spinal instability  
89 in patients suffering from LBP.<sup>2</sup> However, pain often persists post-operatively, attributable to  
90 factors including muscular weakness from spinal muscle dissection, decreased trunk  
91 extensibility, injury to the nervous system as a result to the pre-operative condition, and other  
92 adverse effects.<sup>3</sup> Research has suggested that interventions focusing on correct activation of the  
93 transverse abdominis (TA) during functional tasks decreases pain and functional disability in  
94 individuals experiencing LBP, even at 30-month follow-up.<sup>4</sup> This deep musculature is involved  
95 in the maintenance of intraabdominal pressure and provides a stabilizing effect on the lumbar  
96 spine due to the attachment to the thoracolumbar fascia.<sup>4</sup> The TA often does not contract prior to  
97 limb movement in patients with LBP, and as a result, the spine cannot achieve a safe orientation  
98 prior to the movement.<sup>4,5</sup> As a result, many exercise interventions target recruitment of this  
99 stabilizing musculature.<sup>5</sup>

100 The presence of LBP has been correlated with gluteus medius muscle weakness in  
101 patients with chronic LBP compared to healthy individuals.<sup>6</sup> Additionally, weakness of the  
102 gluteus maximus has been connected to people who experience chronic LBP. EMG fatigue  
103 analyses suggest that maximum voluntary contraction of the gluteus maximus is lower and

104 fatigue is achieved quicker in individuals with LBP compared to those without LBP.<sup>7</sup> Because  
105 of this evidence, proximal hip strengthening is often included in exercise interventions.

106 The aging process has been shown to characteristically modify optimal posture. Flexed  
107 postures frequently occur, which may involve increased thoracic kyphosis, forward head, and  
108 knee flexion.<sup>8</sup> Age-related hyperkyphosis may be described as an exaggerated anterior curve of  
109 the thoracic spine that has been associated with populations >55 years old and may contribute to  
110 ADL difficulty, decreased quality of life, and higher mortality rates.<sup>9,10</sup> It has been suggested  
111 that thorax correction exercises including theraband work to strengthen the back may  
112 significantly contribute to decreased kyphosis angles and forward head, as well as improved  
113 chest expansion.<sup>10</sup> Correspondingly, postural correction exercises to strengthen the back may be  
114 appropriate for the older population with severely flexed postures, as well as post-surgical  
115 patients who have undergone spinal fusions and demonstrate age-related postural changes.

116 Although there is abundant evidence regarding exercise interventions for patients  
117 suffering from LBP, there is limited research investigating the efficacy of treatment focusing on  
118 core and lower extremity strengthening, stretching, and balance training for forward-flexed  
119 individuals s/p spinal fusion. The purpose of this case report is to describe the management and  
120 functional improvement of a patient with high levels of LBP, severe postural impairments, and  
121 elevated fall-risk after a thoracolumbar spinal fusion, while utilizing the principles of core and  
122 lower extremity strengthening, stretching, and balance training.

123

#### 124 **CASE DESCRIPTION: PATIENT HISTORY and SYSTEMS REVIEW**

125 The patient was a 68-year-old male presenting to physical therapy eight weeks' s/p  
126 posterior instrumented T11-L5 thoracolumbar spinal fusion with pedicle screws. He was

127 diagnosed with lumbar spondylosis and multiple levels of spinal segment instability prior to  
128 surgery. The patient remained in the hospital for three nights postoperatively, received two  
129 weeks of subacute rehabilitation at a skilled nursing center, and was discharged home and  
130 received home care physical therapy until his sixth week post-surgery. At the time of the  
131 examination, he denied feeling lower extremity pain, numbness/tingling, gross weakness,  
132 bowel/bladder changes, or saddle paresthesia. See Table 1 for the results of the systems review.

133         The patient's past medical history included a pulmonary embolism four years ago,  
134 COPD, and a history of smoking. Postoperatively, he smoked two packs of cigarettes per day.  
135 X-rays were performed ~1 month postoperatively and demonstrated good healing as per patient  
136 report. At the time of the initial evaluation (IE), his medications included Coumadin 2.5 mg  
137 3x/week and Oxycontin 10 mg as needed. The patient did not engage in any form of exercise  
138 preoperatively and was not working at the time of the IE. One year prior to surgery, he was  
139 working full time as an established guitar teacher at a prestigious performing arts college. The  
140 patient lived alone in a single level apartment and relied on his daughter as his main support  
141 system. He used a rolling walker in the community, as he had for at least a year preoperatively,  
142 but chose to not use an assistive device at home.

143         At the IE, the patient could tolerate five minutes of walking and two minutes of standing  
144 before needing to sit. He described an intermittent, aching LBP rated 3-8/10 on the Numeric Pain  
145 Rating Scale (NPRS). Additional functional limitations included the inability to lay supine,  
146 stand up straight, walk, or cough, without aggravating his symptoms. His goals for physical  
147 therapy were to stand up straight, restore his normal tolerance to walking/standing >20 minutes,  
148 and to return to work as a guitar teacher. The patient verbalized and documented his consent to  
149 participate in this case report.

150 **CLINICAL IMPRESSIONS 1**

151 At IE, it was hypothesized that, in addition to postoperative impairments resulting from a  
152 thoracolumbar spinal fusion, the case involved differential diagnoses of sacroiliac disease,  
153 quadratus lumborum/paraspinal strain, hip joint pathology, or disc/facet dysfunction at other  
154 spinal segments. The patient was a strong candidate for this case report because of the unique  
155 combination of levels fused and his motivation to improve his posture. Examination included  
156 pain, ROM, muscle length, posture, gait, and pain assessments, as well as manual muscle testing  
157 (MMT), palpation, deep tendon reflexes (DTR), dermatome testing, and administration of the  
158 Oswestry Disability Index (ODI). Utilization of these tests and measures was beneficial in the  
159 identification of musculoskeletal impairments related to the patient's pain, activity limitations,  
160 and functional limitations.

161

162 **EXAMINATION- TESTS and MEASURES**

163 The ODI [appendix 1] is a widely used condition-specific outcome measure that tracks  
164 functional disability changes in individuals who present with LBP and has been shown to have  
165 good long term test-rest reliability and validity.<sup>12</sup> At the IE, the patient's ODI indicated 54%  
166 disability.

167 The patient lacked the ~45 degrees of lumbar extension that would allow him to achieve  
168 an upright posture, and remaining motions were not tested due to post-surgical precautions and  
169 pain levels. Posture was assessed in standing; postural deviations included a severely forward  
170 flexed trunk, rounded shoulders, protracted scapulas, hyperextension of upper cervical spine,  
171 increased flexion of lower cervical spine, and bilateral knee flexion contractures of ~20 degrees  
172 with bilateral genu varum while in standing.<sup>9,10</sup> Subsequently, the patient's gait was observed as



173 he walked with a rolling walker; he ambulated with a severely flexed posture at the trunk, a step  
174 through pattern with a narrow base of support, and decreased knee extension at terminal swing  
175 phase/heel strike.

176 MMT was utilized to assess the patient's strength; it has been shown to have good  
177 concurrent validity and reliability.<sup>13</sup> The patient demonstrated weakness in all lower extremity  
178 as assessed through MMT and functional strength assessment [Table 2].

179 Although the patient was able to achieve a neutral position during hip flexor muscle  
180 length assessment, severe restrictions were noted bilaterally. Hamstring length was tested in 30  
181 degrees of long sit due to positional restrictions. The patient's 90/90 hamstring length was 45  
182 degrees from 0 bilaterally, suggesting severe hamstring tightness. Hip flexor restrictions may  
183 cause a forward flexed posture at the trunk, limit hip extension ROM, and increase anterior  
184 pelvic tilt, while tight hamstrings can place strain on the low back and bring the pelvis into a  
185 posterior tilt. <sup>(5,14,15)</sup>

186 The patient's DTR and dermatomes were assessed to rule out neurological issues that  
187 may have been present pre-surgery or may have arisen post-surgery. DTRs were absent  
188 bilaterally, which was not a cause for concern. Dermatome testing, using light touch, yielded  
189 unremarkable results.

190 Palpation was performed in a side-lying position due to the patient's inability to assume a  
191 prone or supine position. Mild tenderness and increased "mushy" soft tissue consistency of  
192 bilateral thoracolumbar paraspinals/quadratus lumborum and upper glutes were noted, likely due  
193 to muscle atrophy/disuse.<sup>16</sup>

194

195 **CLINICAL IMPRESSIONS 2**

196           The patient presented to physical therapy s/p spinal fusion, which was required as the  
197 result of lumbar spinal instabilities. Because the patient was unable to work as music teacher  
198 due to difficulty ambulating and standing greater than three minutes, his primary PT diagnoses  
199 were impaired posture, impaired core/lower extremity strength, and low back pain. The ICD-10  
200 chosen was M53.2X6 “Lumbar Spinal Instabilities”. The observed impairments and functional  
201 limitations, including high pain levels, significant disability as measured by the ODI, forward  
202 flexed posture, gait deviations, and limited ROM were consistent with post-surgical impairments  
203 of a T11-L5 spinal fusion.

204           There were no “red flag” concerns that required referral to other health care professionals  
205 or further consultation at the IE. The patient agreed to attend follow-ups with his doctor  
206 regarding the healing of the fusion and incision. Given the patient’s eagerness to achieve postural  
207 and functional improvements, his motivation to resume his career, and his numerous  
208 impairments that could be addressed with physical therapy, he remained a good candidate for  
209 this case report. The patient was willing to work hard and agreed to be compliant with his home  
210 exercise program (HEP).

211           The patient presented with a fair prognosis in terms of proper post-surgical healing,  
212 decreasing LBP, and improving posture, strength, and balance. Potential barriers to achieving  
213 optimal improvements included the patient’s habit of smoking two packs per day  
214 postoperatively, as well as his lack of previous exercise. In a study comparing cigarette smoking  
215 to smoking cessation on fusion rate after spinal fusion surgery, 26.5% of patients who continued  
216 to smoke postoperatively had a nonunion compared to a nonunion rate of 17.1% for cessation,  
217 and 14.2% for patients who were nonsmokers.<sup>11</sup> Although further research is warranted, if the  
218 patient had quit smoking prior to the surgery, it may have improved the ability of T11-L5 to heal

219 optimally. A study investigating the prognostic factors for the reduction of ADLs following  
220 vertebral fractures suggested that a lack of regular exercise may be associated with reduced  
221 ability to perform ADLs.<sup>17</sup> Although the patient was not post vertebral fracture, he had never  
222 engaged in regular exercise and was expected to experience similar difficulties.

223         After confirming post-surgical precautions with the physician, it was decided that  
224 physical therapy frequency would consist of two visits per week for six weeks. At the eighth  
225 visit, all tests and measures would be re-administered to see if the patient could benefit from  
226 further treatment. Aerobic exercises, balance training, core/lower extremity strengthening,  
227 stretching exercises, and gait training would be included in the plan of care. The Berg Balance  
228 Scale (BBS) and Dynamic Gait Index (DGI) were planned to be administered to quantify  
229 observable balance impairments. See table 3 for short/long term goals.

230

## 231 INTERVENTION

232

233         Coordination and communication with the patient's surgeon regarding specific post-  
234 surgical protocol and precautions were utilized to develop an effective and safe treatment plan.  
235 Aside from a 25-lb weight lifting precaution, the surgeon did not ask for further precautions to be  
236 followed. At the first daily visit, the patient was educated on how to assume a thirty-degree  
237 long-sit position at home so that the initial HEP could be performed [Table 4].

238         Procedural interventions focused on therapeutic exercise. A manual stretching program  
239 for hamstring and hip flexor muscle lengthening was appropriate to reduce unnecessary stress on  
240 the spine, correct pelvic position and forward posture, and improve ease of functional activities.  
241 The patient's hamstring tightness may have influenced his lumbopelvic rhythm and contributed  
242 to postural impairments and compensatory movements. Forward bending is repetitively utilized

243 during many ADLs, and restricted hamstring length had the potential to increase the risk of  
244 injury from mechanical stressors to the patient's spine.<sup>15</sup> In order to maximize patient safety  
245 and comfort, manual hip flexor stretching was performed in side-lying and manual hamstring  
246 stretching was performed in modified supine position with the head of the bed at 30 degrees.  
247 Standing pectoralis stretching in a door frame was initiated at the 11<sup>th</sup> visit and added to the HEP  
248 on the 12<sup>th</sup> visit in order to promote opening of the chest wall and decrease forward shoulders.

249 The recumbent bike was initiated on the third visit in order to introduce light aerobic  
250 training, increase blood flow to the extremities and trunk, and activate the core and lower  
251 extremity musculature. Research suggests that exercise training in the individual with COPD is  
252 beneficial in improving in oxygen uptake and endurance time, reducing symptoms of COPD, and  
253 increasing oxidative capacity.<sup>18</sup> Although the patient only rode the recumbent bike for 10  
254 minutes at each visit, he was educated on the importance of utilizing a gym membership to  
255 reduce his COPD symptoms and make steadier improvements.<sup>18</sup>

256 Core stabilization exercises involving Transverse Abdominis (TA) recruitment in 30  
257 degrees of long sitting were introduced at the first follow-up visit in order to increase patient  
258 activity tolerance and global impression of recovery.<sup>19</sup> The patient was educated on how to  
259 recruit this muscle while performing functional activities in order to protect the spine. Posterior  
260 pelvic tilts in conjunction with hip adduction strengthening was also introduced at the first  
261 follow-up visit in order to increase lumbopelvic stability and blood flow in patients.<sup>3</sup> These  
262 exercises were added to the patient's HEP [Table 4].

263 Glute strengthening, such as clamshells, standing hip abduction, sit to stand, step ups,  
264 lateral theraband walks, and standing hip extension were included to target musculature that was  
265 weak during MMT and functional analysis at the IE. Gluteus maximus and medius functional

266 strengthening was included to help the patient control movements of the torso, hips, and legs,  
267 and improve performance of functional activities. Progression of these exercises was gradual, as  
268 the patient demonstrated slow improvements in standing endurance and aerobic capacity and  
269 required frequent rest breaks [Table 4].

270 Postural reeducation including rows, shoulder extensions, bilateral shoulder external  
271 rotation, chin tucks, and angels and chicken wings against a foam roller was initiated to improve  
272 activation, endurance, and muscle length of the postural muscles. Although a completely vertical  
273 posture was unattainable, the goal for this intervention was to allow the patient to improve  
274 upright posture with tactile feedback from the foam roller, while focusing on decreasing rest  
275 breaks [Table 4].

276 During the sixth visit, the patient scored a 43/56 on the BBS and a 16/24 on the DGI,  
277 which was predictive of fall risk in the elderly. Balance training has been shown to be crucial in  
278 reducing fall risk and rate of falls in older adults.<sup>2</sup> Because of this evidence, the patient's fall  
279 risk scores, and observable poor weight shifting strategies, balance training was incorporated into  
280 the patient's procedural interventions [Table 5].

281 Because the patient was adamant about trying aquatic therapy, visit 17 and 18  
282 compromised aquatic therapy sessions focusing on all lower extremity strengthening that had  
283 been previously initiated on land. After these two sessions, the patient received a HEP of all  
284 pool exercises.

285  
286 **OUTCOME**

287  
288 Over the course of 18 physical therapy treatments, the patient demonstrated mild subjective  
289 and functional improvements, which were supported by the ODI and the NPRS [Table 2].  
290 Although the DGI (16/24) and BBS (43/56) were unchanged from the initial measure, the patient

291 was able to maintain balance with perturbations at his trunk, reach beyond his base of support in  
292 varying directions, and improve his hip and ankle strategies during weight shift. He  
293 demonstrated a more upright posture during ambulation, but continued to have decreased knee  
294 extension during terminal swing/heel strike. Unfortunately, he was unable to return to work.

295 The patient demonstrated mild postural improvements in scapular retraction as well as  
296 decreased rounded shoulders, forward head, and forward flexed trunk to ~15 degrees. Although  
297 scapular retraction/depression MMT were not performed at the IE, the patient's scapular  
298 retractors/depressors were 4-/5 by the final visit. The patient's iliopsoas muscle lengths improved  
299 to moderate restrictions, and his 90/90 hamstring lengths improved to ~20 degrees from 0  
300 degrees. By the final visit, the patient reported improved tolerance to lying flat on his back and  
301 decreased difficulty with transferring from his recliner to standing and negotiating stairs, but no  
302 significant difference in standing or walking tolerance. Please see Table 2 for MMT and  
303 functional strength improvements.

304  
305

## 306 **DISCUSSION**

307 The effectiveness of various physical therapy treatment approaches for patients suffering  
308 from LBP has been thoroughly demonstrated in the literature. However, there is limited research  
309 available that investigates the efficacy of treatment focusing on lower extremity strengthening,  
310 flexibility, and balance training in an individual following a thoracolumbar spinal fusion with  
311 associated postural impairments. It has been suggested that balance training is effective in  
312 improving proactive and reactive balance strategies as well as improving performance on balance  
313 outcome measures.<sup>2</sup> Research also shows that a lumbopelvic stabilization training program  
314 including posterior pelvic tilts in conjunction with lower extremity movement increases

315 lumbopelvic stability and blood flow in patients with chronic non-specific LBP.<sup>3</sup> Additionally,  
316 gluteus medius weakness in people with chronic LBP in comparison to healthy controls has been  
317 suggested to be prevalent.<sup>6</sup> The plan of care incorporated interventions that coincided with this  
318 evidence in order to yield the best possible outcomes.

319         Stretching, lower extremity strengthening, and balance training in an individual who is  
320 s/p T11-L5 spinal fusion may yield modest outcomes. The patient demonstrated fair  
321 improvements in MMT measurements and muscle length, good functional strength  
322 improvements, and mild improvements in balance. The most significant improvement was seen  
323 in the patient's decreased forward flexed posture from ~45 degrees to ~15 degrees.

324         Among the numerous negative effects of cigarette smoking, there is an apparent adverse  
325 influence on the spine. Cigarette smoking has been shown to inhibit lumbar spinal fusion and  
326 adversely affect the outcome of returning to work compared to nonsmokers or patients who quit  
327 smoking after surgery.<sup>11</sup> Despite the patient's functional improvements, he was unable to return  
328 to work due to persistent positional limitations, moderate pain levels, and low standing  
329 endurance of ~3 minutes. A study that compared return-to-work rates in smokers and quitters  
330 who had undergone a spinal fusion showed that 53.4% of nonquitters returned to work, but  
331 46.6% remained disabled. In contrast, those who quit smoking for greater than six months after  
332 surgery had a 74.6% return to work rate, and 25.4% remained disabled.<sup>11</sup> Although one cannot  
333 infer a cause and effect relationship between modest outcomes in therapy and smoking in the  
334 patient who is recovering from an extensive spinal fusion, is likely that the patient's excessive  
335 smoking contributed to his inability to return to work and fair improvements demonstrated  
336 throughout the course of therapy. This patient's lifestyle choice presents as a confounding  
337 variable that may have influenced the validity of this case report's finding.

338           In addition to smoking, the patient's lack of previous exercise may have contributed to  
339 modest improvements. Research speculates that patients with regular exercise are less affected  
340 by disuse atrophy during initial phases after spinal fracture.<sup>17</sup> Although the patient did not present  
341 post spinal fracture, disuse atrophy was likely due to postoperative protocol and lack of exercise  
342 habits previously. It has also been suggested that regular exercise should be encouraged to  
343 prevent reduced ADL after vertebral fracture, particularly for elderly individuals.<sup>17</sup> Perhaps if  
344 the patient had exercised prior to his spinal fusion, it would have prevented his reduced ADL  
345 tolerance postsurgically. As a result of this confounding variable, one cannot infer the same  
346 modest results with a patient who exercised preoperatively.

347           The patient's lack of improvement in BBS and DGI scores may have been due to his knee  
348 flexion contractures/osteoarthritis and genu valgum, contributing to his fall risk. A more  
349 comprehensive approach to balance training focusing on knee alignment and range of motion  
350 may have improved outcomes. Additionally, the patient may have been able to achieve a more  
351 upright posture by the final visit if he did not use his rolling walker, which encouraged a flexed  
352 forward posture. However, without using his rolling walker, the patient's fall risk increased.  
353 Using an assistive device to address fall risk was deemed more important than an upright posture  
354 for this individual.

355           The results of this case report suggest that therapy consisting of stretching, lower  
356 extremity strengthening, and balance training may be beneficial additions to the plan of care in a  
357 patient who is s/p multilevel thoracolumbar spinal fusion with associated marked postural  
358 impairments. As with any case report, one cannot infer cause and effect between lower  
359 extremity strengthening, balance training, and stretching, and the clinical improvement of the  
360 patient. However, the significant functional improvements and decreased forward flexed posture



361 suggest that these interventions were likely a contributing factor for his clinical improvement.

362 Further research is warranted to determine the most effective therapeutic protocol for patients

363 presenting with LBP after a spinal fusion surgery.

364

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444 TABLES and FIGURES

**Table 1. Systems Review**

<b>Cardiovascular/Pulmonary</b>	<b>Impaired cardiorespiratory function due to deconditioning and chronic productive, effective cough present at rest and during exercise.</b>
<b>Musculoskeletal</b>	<b>Impaired strength, flexibility, posture, gait, and ROM.</b>
<b>Neuromuscular</b>	<b>Impaired due general unsteadiness/need to hold onto various objects for support during IE.</b>
<b>Integumentary</b>	<b>Impaired. Central thoracolumbar surgical incision T11-L5 healed well, except proximal 2 inches covered by dry exudate. No signs and symptoms of infection or redness.</b>
<b>Communication</b>	<b>No impairments noted.</b>
<b>Affect, Cognition, Language, Learning Style</b>	<b>No impairments noted. Primary language: English.</b>

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446 **TABLE 2. ODI, NPRS, and Strength Examination Results at Initial Evaluation and Final**  
447 **Visit**

<i>Tests and Measures</i>	<i>Initial Evaluation Results</i>			<i>Final Visit Results</i>		
<b>ODI</b>	54% disabled			36% disabled		
<b>NPRS</b>	3-8/10 NPRS			0-5/10 NPRS		
<b>Manual Muscle Testing</b>	<b>Muscle</b>	<b>Left</b>	<b>Right</b>	<b>Muscle</b>	<b>Left</b>	<b>Right</b>
	<i>Iliopsoas</i>	4/5	4/5	<i>Iliopsoas</i>	4/5	4/5
	<i>Quadriceps</i>	4-/5	4-/5	<i>Quadriceps</i>	4+/5	4+/5
	<i>Hamstrings</i>	4-/5	4-/5	<i>Hamstrings</i>	4+/5	4+/5
	<i>Hip External Rotators</i>	4-/5	4-/5	<i>Hip External Rotators</i>	4/5	4/5
	<i>Hip Internal Rotators</i>	4/5	4/5	<i>Hip Internal Rotators</i>	4/5	4/5
	<i>Hip Abductors</i>	3/5	3+/5	<i>Hip Abductors</i>	4-/5	4-/5
	<i>Extensor Hallucis Longus</i>	4+/5	4+/5	<i>Extensor Hallucis Longus</i>	4+/5	4+/5
	Note: Gastrocnemius not tested			Note: Gastrocnemius not tested		

	secondary to observable balance impairments	secondary to observable balance impairments
<b>Functional Strength Analysis</b>	<ul style="list-style-type: none"> <li>• Fair eccentric quadriceps control during stair descent</li> <li>• Slow initiation of STS, multiple attempts needed, use of upper extremities needed</li> <li>• ~30 degrees hip ER side stepping</li> </ul>	<ul style="list-style-type: none"> <li>• Good eccentric quadriceps control during stair descent</li> <li>• One attempt to achieve a full standing position during STS, less use of upper extremities, smoother transition</li> <li>• ~15 degrees hip ER during functional side stepping</li> </ul>

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**TABLE 3: SHORT TERM AND LONG TERM GOALS FOR PHYSICAL THERAPY**

<b>Short Term Goal 1:</b>	Increase lower extremity strength ½ to 1 grade grossly within 3 weeks from 1 <sup>st</sup> visit
<b>Short Term Goal 2:</b>	Will report low back pain no greater than 0-5/10 NPRS within 3 weeks from 1 <sup>st</sup> visit
<b>Short Term Goal 3:</b>	Will improve functional tolerance to walking >10 minutes within 3 weeks from 1 <sup>st</sup> visit
<b>Short Term Goal 4:</b>	Will report 70% compliance to HEP (performed at least one time per day 5/7 days per week) with prescribed therapeutic exercise for home within 3 weeks from 1 <sup>st</sup> visit.
<b>Long Term Goal 1:</b>	Will report 100% compliance to HEP (performed 7/7 days per week) with prescribed therapeutic exercise for home within 6 weeks from 1 <sup>st</sup> visit
<b>Long Term Goal 2:</b>	Will achieve 4+/5 lower extremity strength grossly within 6 weeks from 1 <sup>st</sup> visit
<b>Long Term Goal 3:</b>	Will report low back pain no greater than 0-3/10 NPRS within 6 weeks from 1 <sup>st</sup> visit
<b>Long Term Goal 4:</b>	Will restore normal tolerance to walking/standing >20 minutes within 6 weeks from 1 <sup>st</sup> visit
<b>Long Term Goal 5:</b>	Will achieve a score of ≤ 30% disabled on the Oswestry Disability Index within 6 weeks from 1 <sup>st</sup> visit

450 **TABLE 4: STRENGTHENING AND HEP PROGRESSIONS**

<b>Visit</b>	<b>Strengthening</b>	<b>HEP</b>
Visit 1-4	<ul style="list-style-type: none"> <li>❖ TA recruitment education and performance, 10'</li> <li>❖ PPT's in 30 degrees of long-sitting, 5" holds 20x, and with hip adduction ball squeeze 5" 20x</li> <li>❖ Side-lying clam shells with yellow theraband 2x10 B</li> <li>❖ Standing hip abduction at parallel bars 2x10 B</li> <li>❖ Sit to stand (STS) from high box (2 feet) 2x10</li> </ul> <p><b><u>Visit 2</u></b> as previously added plus initiated below:</p> <ul style="list-style-type: none"> <li>❖ 4" step-ups, 3x10 B at parallel bars</li> <li>❖ Standing hip extension 2x10 B at parallel bars</li> <li>❖ Toe raises B 3x10 at parallel bars</li> <li>❖ Heel raises B 3x10 at parallel bars</li> </ul> <p><b><u>Visit 3</u></b> as previously added plus initiated/progressed below:</p> <ul style="list-style-type: none"> <li>❖ 6" step ups 2x10 B, Std. hip extension 3x10 B, D/c toe/heel raises to HEP</li> </ul> <p><b><u>Visit 4</u></b> as previously added plus initiated/progressed below:</p> <ul style="list-style-type: none"> <li>❖ Std. hip abd. at parallel bars 3x10 B</li> <li>❖ 6" step ups 3x10 B</li> <li>❖ Std. quadriceps stretch on middle box (1.5 feet) with UE support on chair 30"x3 B</li> <li>❖ Seated rows using red theraband (RTB) 2x10</li> <li>❖ Shoulder extension using RTB 2x10 B</li> <li>❖ Standing chin tucks 5" x10</li> <li>❖ Seated B shoulder ER using RTB 2x10</li> </ul>	<ul style="list-style-type: none"> <li>○ Posterior pelvic tilt 5" hold 20x</li> <li>○ Posterior pelvic tilt 5" hold with 5" adduction soft ball squeeze 20x</li> </ul> <p><b><u>Visit 2 added:</u></b></p> <ul style="list-style-type: none"> <li>○ B Toe raises 3x10 at kitchen counter</li> <li>○ B Heel raises 3x10 at kitchen counter</li> </ul> <p><b><u>Visit 4 added:</u></b></p> <ul style="list-style-type: none"> <li>○ Quadriceps/iiliop soas stretch on chair with UE support 30"x3 B every day</li> <li>○ Supine hamstring stretch using belt with HOB elevated to 30 degrees 30"x3 B every day</li> </ul>
Visit 5-8	<p><b><u>Visit 5</u></b> as previously added plus progressed below:</p> <ul style="list-style-type: none"> <li>❖ STS from high box 3x10</li> <li>❖ Seated rows using RTB 3x10</li> <li>❖ Shoulder extension using RTB 3x10 B</li> </ul> <p><b><u>Visit 6</u></b> as previous added.</p> <p><b><u>Visit 7</u></b> as previously added plus progressed below:</p> <ul style="list-style-type: none"> <li>❖ STS from low mat 3x6</li> <li>❖ Std. rows/shoulder ext. green theraband (GTB) 2x15</li> <li>❖ Std. hip abd. with yellow theraband (YTB) loop around ankles 2x10 and 1x10 no band</li> <li>❖ Std. hip extension with 2# 2x10 with poor form, d/c from Tx</li> </ul> <p><b><u>Visit 8</u></b> as previously added plus progressed below:</p> <ul style="list-style-type: none"> <li>❖ STS from low mat 2x10 and 1x7</li> </ul>	<p><b><u>Visit 5 added:</u></b></p> <ul style="list-style-type: none"> <li>○ Std. B hip abd. with UE support 3x10 every other day</li> </ul> <p><b><u>Visit 8 added:</u></b></p> <ul style="list-style-type: none"> <li>○ Std. hamstring curl with UE support 3x10 B every other day</li> <li>○ Step ups on bottom step of staircase with railing assist 6" 3x10 B every</li> </ul>

	<ul style="list-style-type: none"> <li>❖ YTB lateral bandwalks with UE hand-held assist 25"x4</li> <li>❖ Std. hamstring curl 2x10 B 0#</li> <li>❖ Std. chicken wings against foam roller 5" holds 10x each position</li> <li>❖ Std. angels against foam roller 20x</li> </ul>	<ul style="list-style-type: none"> <li>○ other day</li> <li>○ STS from kitchen chair 3x10 every other day</li> <li>○ Chin tucks 5" hold 20x every day</li> </ul>
Visit 9-16	<p><b><u>Visit 9 and 14</u></b> <i>Re-evaluations</i></p> <p><b><u>Visit 10, 11, 12</u></b> <i>as previously added</i></p> <p><b><u>Visit 13</u></b> <i>as previously added plus progressed below:</i></p> <ul style="list-style-type: none"> <li>❖ STS from low back 3x10</li> <li>❖ Step ups 8" 3x6 B</li> </ul> <p><b><u>Visit 15</u></b> <i>as previous added plus initiated/progressed below:</i></p> <ul style="list-style-type: none"> <li>❖ Step ups 8" 2x10 B</li> <li>❖ Bridging 3x6</li> </ul> <p><b><u>Visit 16</u></b> <i>as previous added plus progressed below:</i></p> <ul style="list-style-type: none"> <li>❖ Step ups 8" 3x10 B</li> <li>❖ Bridging 2x10 B</li> </ul>	<p><b><u>Visit 9 added:</u></b></p> <ul style="list-style-type: none"> <li>○ Std. rows and shoulder extensions using GTB 2x15 B</li> </ul> <p>○ <b><u>Visit 12 added:</u></b></p> <ul style="list-style-type: none"> <li>○ Std. pec stretch in door way 30"x3 B</li> </ul> <p>○ <b><u>Visit 16 added:</u></b></p> <ul style="list-style-type: none"> <li>○ Bridging 2x10</li> </ul>

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464 **Appendix 1: Modified Oswestry Low Back Questionnaire**

465 *The Modified ODI was one of the outcome measures administered to the patient at initial evaluation. The*  
466 *patient was asked to circle that number that most accurately represents his symptoms. © Copyright 2015*  
467 *<http://www.the-rheumatologist.org/>*

Please read: This questionnaire is designed to enable us to understand how much your low back pain has affected your ability to manage your everyday activities. Please answer each section by circling the ONE CHOICE that most applies to you. We realize that you may feel that more than one statement may relate to you, but PLEASE, CIRCLE JUST THE ONE CHOICE THAT MOST CLOSELY DESCRIBES YOUR PROBLEM RIGHT NOW.

**SECTION 1—Pain Intensity**  
1. The pain comes and goes and is very mild.  
2. The pain is mild and does not vary much.  
3. The pain comes and goes and is moderate.  
4. The pain is moderate and does not vary much.  
5. The pain comes and goes and is severe.  
6. The pain is severe and does not vary much.

**SECTION 6—Standing**  
1. I can stand as long as I want without pain.  
2. I have some pain while standing but it does not increase with time.  
3. I cannot stand for longer than one hour without increasing pain.  
4. I cannot stand for longer than 1/2 hour without increasing pain.  
5. I cannot stand for longer than 10 minutes without increasing pain.  
6. I avoid standing, because it increases the pain straight away.

**SECTION 2—Personal Care**  
1. I would not have to change my way of washing or dressing in order to avoid pain.  
2. I do not normally change my way of washing or dressing even though it causes some pain.  
3. Washing and dressing increase the pain, but I manage not to change my way of doing it.  
4. Washing and dressing increase the pain, and I find it necessary to change my way of doing it.  
5. Because of the pain, I am unable to do some washing and dressing without help.  
6. Because of the pain I am unable to do any washing and dressing without help.

**SECTION 7—Sleeping**  
1. I get no pain in bed.  
2. I get pain in bed, but it does not prevent me from sleeping well.  
3. Because of my pain, my normal night's sleep is reduced by less than 1/4.  
4. Because of my pain, my normal night's sleep is reduced by less than 1/2.  
5. Because of my pain, my normal night's sleep is reduced by less than 3/4.  
6. Pain prevents me from sleeping at all.

**SECTION 3—Lifting**  
1. I can lift heavy weights without extra pain.  
2. I can lift heavy weights, but it causes extra pain.  
3. Pain prevents me from lifting heavy weights off the floor.  
4. Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned (e.g., on a table).  
5. Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.  
6. I can lift only very light weights, at the most.

**SECTION 8—Social Life**  
1. My social life is normal and gives me no pain.  
2. My social life is normal, but increases the degree of my pain.  
3. Pain has no significant effect on my social life apart from limiting my more energetic interests (e.g., dancing, etc.).  
4. Pain has restricted my social life, and I do not go out very often.  
5. Pain has restricted my social life to my home.  
6. I have hardly any social life because of the pain.

**SECTION 4—Walking**  
1. Pain does not prevent me from walking any distance.  
2. Pain prevents me from walking more than one mile.  
3. Pain prevents me from walking more than 1/2 mile.  
4. Pain prevents me from walking more than 1/4 mile.  
5. I can walk only while using a cane or on crutches.  
6. I am in bed most of the time and have to crawl to the toilet.

**SECTION 9—Traveling**  
1. I get no pain while traveling.  
2. I get some pain while traveling, but none of my usual forms of travel make it any worse.  
3. I get extra pain while traveling, but it does not compel me to seek alternative forms of travel.  
4. I get extra pain while traveling, which compels me to seek alternative forms of travel.  
5. Pain restricts all forms of travel.  
6. Pain prevents all forms of travel except that done lying down.

**SECTION 5—Sitting**  
1. I can sit in any chair as long as I like without pain.  
2. I can sit only in my favorite chair as long as I like.  
3. Pain prevents me from sitting more than one hour.  
4. Pain prevents me from sitting more than 1/2 hour.  
5. Pain prevents me from sitting more than 10 minutes.  
6. Pain prevents me from sitting at all.

**SECTION 10—Changing Degree of Pain**  
1. My pain is rapidly getting better.  
2. My pain fluctuates, but overall is definitely getting better.  
3. My pain seems to be getting better, but improvement is slow at present.  
4. My pain is neither getting better nor worse.  
5. My pain is gradually worsening.  
6. My pain is rapidly worsening.

Comments

Patient's Signature

Date