CASE REPORT

Classification-Based Low Back Pain Management in a Patient: A Case Report

Kristen Dolittle Moran, PT, DPT; [1] Ann Lucado, PT, PhD; [1] Nicholas Orton, PT, DPT, CSCS [1]
[1]Mercer University, College of Health Professions, Doctor of Physical Therapy Program – Atlanta, GA

ABSTRACT

Background: Low back pain is one of the most common reasons for individuals to seek outpatient physical therapy. While it is prevalent, low back pain can be difficult to classify and treat. Multiple evidence-based classification systems exist with varying approaches to treatment. ***Case Description:*** This case report explores the clinical reasoning and decision-making process in treatment of a patient falling into multiple low back pain classification categories based on the impairment/functional-based classification system. The patient discussed is an otherwise healthy 27-year-old female presenting to physical therapy with a chief complaint of an acute flare-up of persistent low back pain. The rationale behind the sequence in which classification categories were addressed, the decisions behind when to change categories based on emerging data, and the intervention strategies implemented to successfully manage this patient are illustrated. ***Outcomes:*** The patient was seen for a total of 13 visits over a span of two months. The outcome measures used in this case report included the Revised Oswestry Disability Index for low back pain and the numeric pain rating scale. At discharge, both outcome measures demonstrated improvement with achievement of all patient goals set at initial visit, return of function, and ability to manage symptoms independently. ***Conclusion:*** Use of the impairment/functional-based classification system approach to low back pain management proved to be both beneficial and effective. This classification-based approach to patient management may assist in clinical decision making when treating individuals with acute flare-ups of persistent low back pain.

Key Words: Clinical Practice Guidelines, Classification-based Approach, Decision Making, Persistent Low Back Pain

Background

Low back pain (LBP) is one of the most common causes for individuals to seek physical therapy treatment. Over a lifespan it is estimated that 80% of the population will experience at least one episode of LBP.[1] On average, Americans collectively spend $85 billion per year on its treatment.[2] Although LBP often resolves on its own, in many instances it becomes persistent, significantly affecting both quality of life and function. While prevalent, LBP can be difficult to classify and treat, is often multifactorial with variable presentations, and can change throughout a patient's episode of care, further contributing to the complicated nature of diagnosis and treatment.

It is recommended in the Guide to Physical Therapy that clinicians use categorization of signs and symptoms to create a diagnosis.[3] Categorization and classification are commonly utilized in the management of LBP. Multiple evidence-based LBP

classification systems exist, with varying approaches to treatment.
Several studies explore the effectiveness of classification in the management of LBP.[4-11] One classification system supported by research is the impairment/functional-based classification system outlined in the LBP clinical practice guidelines.[4] This classification system places patients into categories based on symptoms and impairments. It also provides the primary evidence-based intervention strategies for each category. Limited research is available on the effectiveness of the management of patients with LBP using the classification categories described in the LBP clinical practice guidelines.[4]

Additionally, while it is stated in a variety of sources that the classification category is likely to change throughout a patient's episode of care, [5-7,11] little research exists as to when it is appropriate to do so. It is at the clinician's discretion to determine when to adjust the course of treatment and decide the sequence in which classification categories are addressed based on emerging data. The purpose of this case report is to explore the utilization of a classification-based approach in the treatment of a patient falling into multiple LBP classification categories based on the impairment/functional-based classification system.[4]

Case Description

The patient depicted in this case report was a 27-year-old Caucasian female who presented to outpatient physical therapy with a referral from her primary care physician. She presented with an acute flare-up of persistent LBP with pain in the lumbar region that occasionally moved into the thoracic spine. The case report was approved by the University Institutional Review Board and Office of Research Compliance.

History of Present Condition:

Pain initially began 15 months prior when the patient was squatting while catching a medicine ball at the gym. She felt a "shift" in her lower back and pain began the following day. Since the initial injury, the patient had experienced fluctuating pain switching between lumbar and thoracic regions of the back. Pain was described as a deep ache and was exacerbated by sitting on hard, firm surfaces, running, jumping, sustained positions, and carrying loads. Pain was improved with lying down, core strengthening exercises, active lumbar extension, and NSAIDs. The patient reported pain was worst upon waking in the mornings on her stomach and eased with movement. Sleep was disturbed due to the pain with inability to fall asleep or sleep through the night. The patient received physical therapy following the injury with minimal short-term relief. Physical therapy treatment was administered periodically by colleagues following the initial injury 15 months prior. Previous treatment provided temporary, but not lasting, relief and included dry needling as well as thoracic and lumbar joint mobilizations and manipulations.

Medical History and Screening:

The patient presented with an unremarkable medical history, no comorbidities, and no previous surgeries. Imaging, including radiograph and MRI, were performed prior to referral for physical therapy with no significant findings. The patient was screened for red flags with no signs of non-musculoskeletal origin for her symptoms.

Social History:

Practicing as a full-time outpatient physical therapist, the patient worked a physically demanding job five days per week. Her work required prolonged standing, prolonged sitting to write documentation, and the ability to safely handle and move patients of various sizes. Outside of work, the patient was very physically active,

participating in yoga, cycling, running, strength training, and Pilates. She had not been participating in her typical exercise activities due to her recent flare-up of LBP and was having difficulty performing some work-related duties. She reported an increase in attention paid to her pain in the recent months since the flare-up. Personal factors influencing prognosis included the patient's female gender, age of 27 years old, good overall health, doctorate level of education, profession as a physical therapist with in-depth knowledge and understanding of condition, high level of motivation, and persistent symptoms for greater than 6 months. Environmental factors related to prognosis included physically demanding job, strong family and work support and access to resources, both physical and financial.

Goals:

The patient's goals were to return to exercising without pain and to be able to sleep without waking due to pain. Additionally, she wanted to be able to perform work-related duties including standing, sitting, and handling patients without pain.

Outcome Measures:

Multiple outcome measures were used to determine the level of change with this patient. The Revised Oswestry Disability Index was utilized as the primary outcome measure for this case. The Revised Oswestry consists of 10 questions scored from 0 to 5 by the patient. Scores from each item are summed and divided by the total possible points to calculate the patient's perceived disability. Disability is rated as a percentage from 0% to 100% with higher numbers indicating a higher level of perceived disability. The Revised Oswestry has demonstrated high levels of validity and reliability with good responsiveness to change.[12] A change of 12% on the Revised Oswestry is considered a clinically significant change.[13] The numeric pain rating scale (NPRS) is an 11-point scale ranging from 0 (no pain) to 10 (worst imaginable pain) where the patient can rate their current, best, and worst levels of pain. The NPRS has strong psychometric properties with a change of 2 points considered to be clinically significant.[14]

Physical Examination:

Table 1 displays the objective assessment and associated findings found during the physical examination portion of the initial visit. Impairments identified during the initial examination included postural deviations, gait deviations, pain, mobility deficits, myofascial restrictions, and motor control deficits. Significant findings included a positive slump test bilaterally, a positive prone instability test, impaired lumbar protective mechanism, and reproduction of symptoms with lumbar side bending and rotation.

Evaluation:

The initial physical therapy diagnosis was determined to be LBP with related (referred) lower extremity pain versus LBP with movement coordination deficits secondary to general hypermobility and potential disc pathology. Based on the examination, the patient's prognosis to achieve goals was good. Initially, the plan of care included physical therapy visits two times per week for eight weeks. The functional goals determined with the patient included being able to sit for two hours without an increase in pain in order to perform desk duties at work in eight weeks and returning to fitness and workout activities without pain or compensation in eight weeks.

Table 1: Physical examination findings

Objective Assessment	Findings
Standing/Sitting Posture	· Forward head posture · Internally rotated shoulders · Shoulders shifted posterior to hips · Lateral trunk shift to L · Anterior pelvic tilt · B genu recurvatum · Pes planus B
Functional Activities	
Gait Analysis	· Maintains pronation throughout gait cycle · Medial heel whip B heel off
Double Leg Squat	· No significant findings
Balance	
Single Leg	· No significant findings
Range of Motion	
Lumbar	
Flexion	· Within normal limits
Extension	· Within normal limits
Side Bending	· Limited L>R, L shear noted at initiation of movement · Improved with manual shift correction L --> R
Rotation	· Limited L>R · Improved with manual shift correction L --> R
Quadrant Testing	· Pain with transition from L SB to R SB while maintaining extension
Muscle Length	
Calf Flexibility	· B limited DF with knee extended No limitations with knee flexed
Thomas Test	· Impaired R>L, rectus, psoas, TFL involvement
Resisted Testing	· Symptoms elicited with resistance to extended UEs in standing
Prone Press-up	· Pinching with reproduction of pain
Lumbar Protective Mechanism	· Impaired, more significant in A-->P direction
Neurodynamic Tests	
Slump	· Positive B, R>>L
Special Tests	
Prone Instability	· Positive L2, L4
Palpation	
Psoas	· Increased tone and tenderness R
Gastroc/Soleus	· TrP present R
Fascial Mobility	· Fascial restrictions along B iliac crests, at L5-S1 R>L

Abbreviations: B, bilateral; L, left; R, right; SB, side bending; DF, dorsiflexion; A, anterior; P, posterior; TFL, tensor fascia latae; UE, upper extremity; TrP, trigger point

Classification Categories Considered in Patient Management:

The initial physical therapy diagnosis was determined to be LBP with related (referred) lower extremity pain versus LBP with movement coordination deficits secondary to general hypermobility and potential disc pathology. Based on the examination, the patient's prognosis to achieve goals was good. Initially, the plan of care included physical therapy visits two times per week for eight weeks. The functional goals determined with the patient included being able to sit for two hours without an increase in pain in order to perform desk duties at work in eight weeks and returning to fitness and workout activities without pain or compensation in eight weeks.

Interventions:

The patient was seen for a total of 13 visits over a two-month duration. The interventions utilized throughout the plan of care are provided in Table 3 and images of several exercises are provided in Appendix A. The patient participated in the creation of and agreed to the plan of care. Initially, the patient discontinued her regular exercise routine and only walked in addition to performing her provided home exercises. She returned to light stationary biking after the third visit. She then slowly began adding in additional activities including, hiking, TRX, yoga, and running using a post-ACL return to running protocol provided in Appendix B Table 5.[15]

While the patient was not recovering post-ACL surgery, the return to running protocol provides an objective stepwise plan for individuals to systematically increase their mileage without overloading their tissues.[15] It lays out a progression with strict guidelines for distance and frequency of running. As her loading tolerance improved and she was able to complete each phase without an increase in LBP lasting greater than 24 hours, the patient progressed the program until she was running two miles three days per week. Following discharge, she would continue increasing her mileage until she reached her desired goal of four miles three days per week.

Interventions provided during each treatment session were based on the patient's symptoms and presentation on reassessment. These findings were used to prioritize the most relevant LBP classification category and select appropriate interventions.

Outcomes

No clinically significant change was found in the Revised Oswestry scores from initial visit to discharge, with a total decrease in self-perceived disability of 6%, from a score of 16% at visit 1 to 10% at visit 13. However, at discharge the patient stated she had met all of her functional physical therapy goals with no remaining activity limitations or participation restrictions. She stated she was able to independently manage her low back soreness and was back to fully participating in recreational activities and work duties. A clinically significant decrease was seen in NPRS ratings from initial visit (0/10 at best and 6/10 at worst) to discharge (0/10 at best and 2/10 at worst), however, with a decrease in rating of 'pain at worst' by 4 points.

Table 2: Symptoms and impairments consistent with low back pain impairment/function-based classification categories

Category	Symptoms	Impairments	Example Interventions
Low back pain with mobility deficits	· Acute low back pain · Sensation of back stiffness · Onset of symptoms linked to unguarded/awkward movement	· Lumbar range of motion limitations · Low back symptoms reproduced with provocation of involved segments · Symptoms reproduced with end-range spinal motions · Restricted lumbar and thoracic segmental mobility	· Manual therapy to improve mobility · Therapeutic exercise to improve spinal mobility
Low back pain with movement coordination impairments	· Acute exacerbation of recurring low back pain · Numerous episodes of low back pain in recent years	· Low back pain at rest in sitting, standing, and lying down · Low back symptoms reproduced with provocation of involved segments · Movement coordination impairments of lumbopelvic region with low back extension and side bending · Lumbar segmental hypermobility · Mobility deficits of ribs and thoracic spine · Diminished trunk muscle strength and endurance · Movement coordination impairments while performing work-related and recreational activities	· Neuromuscular re-education to promote dynamic stability · Therapeutic exercises to address trunk and pelvic-region muscle strength and endurance deficits · Exercise-specific activities to return to preferred exercise routine
Low back pain with related (referred) lower extremity pain	· Low back pain with referred buttock pain · Symptoms worsened with sitting	· Pain can be centralized and diminished with repeated extension and extension postures · Limited lumbar extension mobility · Lateral trunk shift present	· Therapeutic exercises, manual therapy, or traction procedures that promote centralization and improve lumbar extension mobility · Patient education in positions that promote centralization

Low back pain with radiating pain	· Low back pain with pain radiating into the extremities · Lower extremity paresthesias and numbness	· Lower extremity radicular symptoms present at rest · Paresthesias worsened with lower limb tension testing/slump test	· Positional interventions to reduce strain or compression on involved nerves · Nerve mobility exercises in a pain-free, non-symptom-producing ranges · Manual or mechanical traction · Manual therapy to mobilize articulations and soft tissue adjacent to the involved nerves that exhibit mobility deficits · Patient education in pain management strategies

Table 3: Interventions and home exercise program

Visit	Assessment	In-Session Treatment & Education	Home Exercise Program	Classification Category of Focus
1	see detailed examination, Table 1	Manual Therapy · direct pressure psoas release Therapeutic Exercise · lateral shift correction on sheets	· lateral shift correction on 3 sheets: 15 min, 3-4x per day	Low back pain with related (referred) lower extremity pain
2	· limited extension with reproduction of pain · limited L SB initiated by shearing · limited L rotation · reproduction of pain with prone press-up - reduction with manual shear correction L->R	Manual Therapy · lumbar rotation joint mobilizations Therapeutic Exercise · prone press-ups · standing lumbar extension	· lateral shift correction on 3 sheets: 15 min, 3-4x per day · standing lumbar extension: 10 reps, 3-4x per day	Low back pain with related (referred) lower extremity pain
3	· same impairments as visit 2 · mild psoas irritability and increased tone B, R>L · decreased lumbar protective mechanism A->P · decreased L DF PROM and talocrural mobility A->P	Manual Therapy · direct pressure psoas release · talocrural joint mobilization Neuromuscular Re-education · pelvic PNF Therapeutic Exercise · prone press-ups · multifidus activation interventions	· lateral shift correction on 4 sheets: 15 min, 3-4x per day · standing lumbar extension: 10 reps, 3-4x per day · posture - focus on maintaining neutral pelvis and shoulders over hips in standing	Low back pain with mobility deficits

4	· paresthesias down legs to B feet · reproduction of tingling in L foot at end range of lumbar flexion · B low back pain with lumbar extension · Slump test negative B · reproduction of tingling in L foot with CPA at L3-L4 and L UPA at L3-L4	Manual Therapy · R UAP lumbar mobilization Therapeutic Exercise · Triple flexion for IAP control	· Triple flexion: 10x10 second hold, 2-3x per day	Low back pain with radiating pain
5	· improvement in tingling and radiating symptoms · improvement in lumbar protective mechanism A->P · decreased anterior oblique sling activation (L serratus anterior, R adductors)	Therapeutic Exercise · UE D2 flexion/extension PNF patterns · Triple flexion with alternating legs marching · DNS - 3-6 month supine to single kneeling	· Triple flexion with marching: 3x10 reps ea side, 2-3x per day · DNS - 3-6 month supine to single kneeling: 10 reps ea side, 2-3x per day	Low back pain with radiating pain
6	· paresthesias subsided · decreased anterior oblique sling activation (L serratus anterior, R adductors)	Therapeutic Exercise · Triple flexion with alternating legs marching holding 5lb weight · DNS - 3-6 month supine to single kneeling progression · DNS - 3 month prone with reaching	· Triple flexion with marching holding 5 lb weight: 3x10 reps ea side, 2-3x per day · DNS - 3-6 month supine to single kneeling: 10 reps ea side, 2-3x per day · DNS - 3 month prone with reaching: 10 reps ea side, 2-3x per day	Low back pain with movement coordination impairments

7	· line of pain across back at lower thoracic spine · restricted thoracic rotation to L at T9	Manual Therapy · Thoracic ring shift correction Therapeutic Exercise · Sagittal plane core strengthening with pulleys · Triple flexion with alternating legs marching holding 5lb weight	Continue with exercises as of visit 6	Low back pain with movement coordination impairments
8	· decreased lumbar protective mechanism A->P · L sided diaphragm restriction along medial ribs · R sided pinching with end range of press-up	Manual Therapy · Diaphragm release Therapeutic Exercise · Sagittal plane core strengthening with pulleys · DNS - 3 month prone with reaching	Continue with exercises as of visit 6	Low back pain with movement coordination impairments
9	· decreased lateral shear with L SB with stacking in lower lumbar spine - improved with manual L->R shear correction · hypomobile and tender L and R UPA at L3 · increased tone and tenderness of R QL with reproduction of R sided lower back pain on palpation	Manual Therapy · Lumbar joint mobilizations · QL release Therapeutic Exercise · L SB in standing · DNS - 6 month prone with reaching and knee slides	· Triple flexion with marching and punches using 5 lb weight: 3x10 reps ea side, 2-3x per day · DNS - 3-6 month supine to single kneeling: 10 reps ea side, 2-3x per day · DNS - 6 month prone with reaching and knee slides: 10 reps ea side, 2-3x per day	Low back pain with movement coordination impairments

10	· decreased lateral shear with L SB with stacking in lower lumbar spine · increased tone and tenderness of R QL	Manual Therapy · QL release Therapeutic Exercise · L SB with kettlebell · DNS - 6 month prone with reaching and knee slides · Sagittal plane core strengthening with pulleys	Continue with exercises as of visit 9	Low back pain with movement coordination impairments
11	· decreased lateral shear with L SB with stacking in lower lumbar spine · increased tone and tenderness of L QL	Manual Therapy · QL release Therapeutic Exercise · L SB with kettlebell · Sagittal plane core strengthening with pulleys · Turkish getups with 7 lb weight	Continue with exercises as of visit 9 · Turkish getups with weight, 2-3x per day	Low back pain with movement coordination impairments
12	· decreased glute max activation in prone · unable to hold full plank on feet with proper form	Therapeutic Exercise · Glute max retraining · Reviewed squat and plank mechanics Pain management and exercise progression education	Continue with exercises as of visit 11	Low back pain with movement coordination impairments
13	· no complaints or findings - discharge visit	Therapeutic Exercise · Triple flexion · Dynamic core exercises including rolling and floor to stand transfers	Continue with exercises as of visit 11 Return to desired exercise routine	Low back pain with movement coordination impairments

Abbreviations: L, left; SB, side bending; R, right; ROM, range of motion; B, bilateral; A, anterior; P, posterior; DF, dorsiflexion; PROM, passive range of motion; PNF, proprioceptive neuromuscular facilitation; CPA, central posterior to anterior; UPA, unilateral posterior to anterior; UAP, unilateral anterior to posterior; IAP, intraabdominal pressure; DNS; dynamic neuromuscular stabilization; QL, quadratus lumborum

Discussion

Outcomes for this patient suggest a classification-based approach to the management of LBP is beneficial and effective. With treatment guided by the impairment/functional-based classification approach,[4] the patient was able to meet her goals and return to exercising and working with the ability and confidence to independently manage her LBP.

Throughout the duration of the plan of care, the impairment/functional-based classification category of focus changed several times. Each visit, the patient was reassessed to determine current symptoms, any changes since the previous visit, and response to interventions. On initial evaluation, the patient presented with symptoms consistent with LBP with related (referred) lower extremity pain and LBP with movement coordination deficits categories. Therefore, initially treatment was focused on centralizing the patient's LBP, improving the patient's lateral trunk shift, and facilitating increased movement into lumbar extension. Direction-based interventions were implemented to achieve these goals. Once the patient's symptoms were centralized and located more focally in the low back, the plan was to switch the category of focus to LBP with movement coordination deficits to promote motor control, stability, and muscle endurance, in order to improve the patient's ability to perform work-related and recreational activities.

As symptoms began to centralize at visit 3, mobility deficits persisted, so the category of focus was instead shifted to LBP with mobility deficits. Manual therapy techniques were applied in addition to therapeutic exercises to promote spinal mobility. On the following visit, the patient presented with emerging symptoms of paresthesias into the lower extremity to the foot. Symptoms were consistent with the LBP with radiating pain category, and as such, focus of treatment was shifted to this category. Once the radiating pain was resolved at visit 6, the decision was made to finally focus on the category of LBP with movement coordination deficits, which remained the focus for the duration of the plan of care. Interventions in this category consisted of exercises to improve intraabdominal pressure and control as well as anterior oblique sling activation for core stability. Improvement of core stability and control would reduce stresses being placed on the low back and minimize overactivation of the spinal extensors, which would result in reduced compressive loads on the spine.

This case demonstrates that by responding to emerging data, fluctuating LBP symptoms can be effectively managed. Performing an assessment and reassessment each visit is important to determine whether patients with LBP have changed classification categories. This allows therapists to be more efficient in treatment and avoid wasting unnecessary time and resources. Previous research has explored the benefits of utilization of a classification system in the treatment of LBP, but not specifically the dynamic use of the impairment/functional-based classification system throughout a plan of care.[16] Low back pain is fluid, and it is common for symptoms to change frequently. Alrwaily and colleagues[5] describe a dynamic approach using a treatment-based classification system to inform treatment. This case report is similar in the dynamic clinical reasoning they described;[5] however, this case report differs in that we utilized changes in impairments between visits to drive intervention selection.

It is important for therapists to be systematic and intentional in their intervention selection, limiting addition of many different interventions each visit. When utilizing a

classification approach to LBP management, treatment should be focused on prioritizing one LBP classification category at a time. Once appropriate, based on patient presentation, therapists can shift treatment to focus on a different category.

This case report has several limitations. The patient involved in this case report was very active and educated with no comorbidities. Results may differ for older, less educated, less active individuals with multiple comorbidities. This case report involved the management of a patient with an acute flare-up of persistent LBP and did not investigate classification in management of patients with varying acuity of LBP. The Revised Oswestry has a floor effect of 29.9%,[17] which is higher than the patient's initial score, despite her significant complaint of decrease in function and numerous impairments determined through objective tests and measures. This may have contributed to the lack of a clinically significant change in level of self-reported disability from initial visit to discharge. The Patient Specific Functional Scale is an outcome measure that shows self-reported improvement in activities important to the patient that has high test-retest reliability with LBP and could have been used as an additional outcome measure to determine functional improvement.[18]

Further research is needed to determine the effectiveness of using the impairment/functional-based classification system in management of patients with initial episodes of acute LBP or with chronic LBP in a larger sample. Researchers could also look at comparing use of the impairment/functional-based classification system with other evidence-based classification systems to determine whether one is more effective than another. Additionally, future research could compare outcomes following initial classification treatment for the whole duration of care versus outcomes with a dynamic classification treatment approach, such as that used in this case report, to determine effectiveness.

Conclusion

With the high prevalence of LBP, it can be assumed that more individuals with symptoms in multiple LBP classification categories will seek physical therapy treatment in the future. It is important that physical therapists understand how to manage patients effectively and efficiently to avoid unnecessary costs of prolonged treatment. Effective management is essential to improve patients' function and quality of life and decrease future healthcare costs and potential long-term issues of chronic LBP. Use of the impairment/functional-based classification system can be a systematic, evidence-based option for managing patients with LBP.

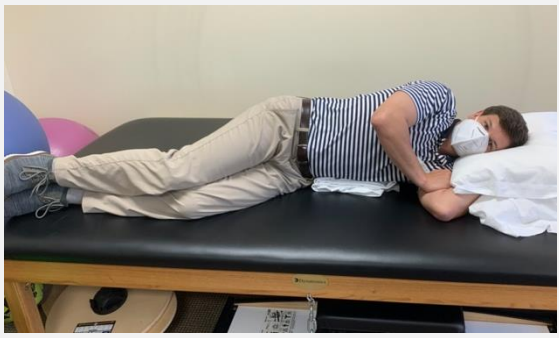
References

1. Freburger JK, Holmes GM, Agans RP, et al. The rising prevalence of chronic low back pain. *Arch Intern Med.* 2009; 169(3):251-258. doi:10.1001/archinternmed.2008.543.
2. Martin BI, Deyo RA, Mirza SK, et al. Expenditures and health status among adults with back and neck problems. *JAMA.* 2008;299(6):656-664. doi:10.1001/jama.299.6.656.
3. *Guide to Physical Therapist Practice 3.0.* Alexandria, VA: American Physical Therapy Association; 2014. Available at: http://guidetoptpractice.apta.org/. Accessed August 27, 2020.
4. Delitto A, George SZ, Van Dillen L, et al. Low back pain. *J Orthop Sports Phys Ther.* 2012;42(4):A1-A57. doi:10.2519/jospt.2012.42.4.A1.
5. Alrwaily M, Timko M, Schneider M, et al. Treatment-based classification system for low back pain: revision and update. *Phys Ther.* 2016;96(7):1057-1066. doi:10.2522/ptj.20150345.

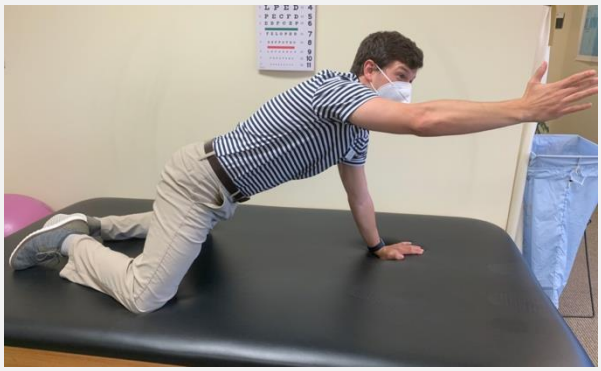
6. Fritz JM, Delitto A, Erhard RE. Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain. *Spine.* 2003;28(13):1363-1372.
7. Brennan GP, Fritz JM, Hunter SJ, Thackeray A, Delitto A, Erhard RE. Identifying subgroups of patients with acute/subacute "nonspecific" low back pain. *Spine*. 2006;31(6):623-631.
8. Fairbank J, Gwilym SE, France JC, et al. The role of classification of chronic low back pain. *Spine.* 2011;36(21):S19-S42. doi: 10.1097/BRS.0b013e31822ef72c.
9. Petersen T, Laslett M, Juhl C. Clinical classification in low back pain: best-evidence diagnostic rules based on systematic reviews. *BMC Musculoskelet Disord.* 2017;18(1):188. doi: 10.1186/s12891-017-1549-6.
10. Hensley CP, Courtney CA. Management of a patient with chronic low back pain and multiple health conditions using a pain mechanisms-based classification approach. *J Orthop Sports Phys Ther*. 2014;44(6):403-414.
11. Pinto D, Cleland J, Palmer J, Eberhard SL. Management of low back pain: a case series illustrating the pragmatic combination of treatment- and mechanism-based classification systems. *J Man Manip Ther*. 2007;15(2):111-122.
12. Cleland J, Gillani R, Bienen EJ, Sadosky A. Assessing dimensionality and responsiveness of outcome measures for patients with low back pain. *Pain Pract.* 2011;11(1):57-69.
13. Fritz JM, Herbert J, Koppenhaver S, Parent E. Beyond minimally important change: defining a successful outcome of physical therapy for patients with low back pain. *Spine.* 2009;34(25):2803-2809. doi:10.1097/BRS.0b013e3181ae2bd4.
14. Childs JD, Piva SR, Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine*. 2005;30:1331-1334. Doi:10.1097/01.brs.0000164099.92112.29.
15. Manal TJ, Grieder AS, Kist BW. The knee: physical therapy patient management using current evidence. *Current concepts of orthopaedic physical therapy*. 4th ed; 2016.
16. George SZ, Fritz JM, Silfies SP, Schneider MJ, Beneciuk JM, Lentz TA, Gilliam JR, Hendren S, Norman KS. Interventions for the Management of Acute and Chronic Low Back Pain: Revision 2021. *J Orthop Sports Phys Ther*. 2021;51(11):CPG1-CPG60. doi: 10.2519/jospt.2021.0304.
17. Brodke DS, Goz V, Lawrence BD, Spiker WR, Neese A, Hung M. Oswestry disability index: a psychometric analysis with 1,610 patients. *Spine*. 2017;17(3):321-327. Doi:10.1016/j.spinee.2016.09.020.
18. Patient Specific Functional Scale. Shirley Ryan AbilityLab. https://www.sralab.org/rehabilitation-measures/patient-specific-functional-scale. Accessed October 12, 2020

APPENDIX A

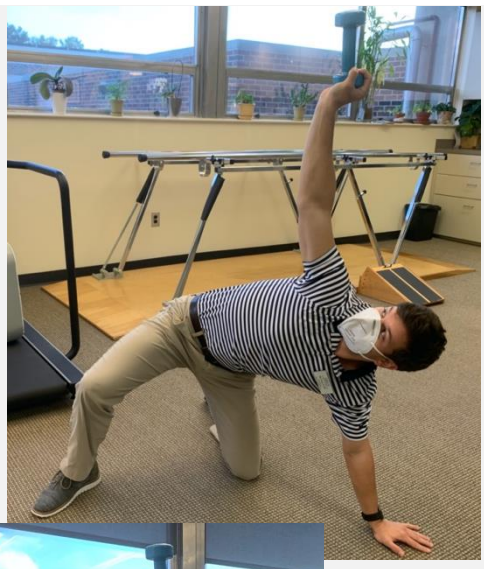
Depiction and description of several interventions performed throughout the plan of care. Intervention parameters, including repetitions and frequency, are listed in **Table 3**.

Exercise	Description	Visual Depiction
Lateral shift correction on sheets	· Patient in sidelying with lateral trunk on stack of folded sheets. · Sheets are positioned below axilla and above iliac crest. · Patient should be laterally shifted and not side bent over sheets.	
Triple flexion	· Patient in supine with shoulders, hips and knees flexed to 90 degrees. · Focus on diaphragmatic breathing and minimizing rib flaring. · Position intended to help maintain intraabdominal pressure to create core stability.	
Triple flexion with marching	· Progression of static triple flexion intervention. · Single leg marching in triple flexion position. · Focus of exercise to maintain intraabdominal pressure during dynamic movements of the lower extremities. · Weight added for cue to maintain serratus punch to help activate anterior oblique sling for core stability.	

DNS - 3-6 month supine to single kneeling transition	· Transition from supine through side plank on knees to low lunge with forward reaching. · Intended to activate obliques and maintain core stability throughout dynamic transitional movement.	  
DNS - 3 month prone with reaching	· Activating anterior oblique sling to lift trunk in prone and reach forward with contralateral arm.	

DNS - 6 month prone	· Modified quadruped position with knees posterior to hips, feet together, and knees apart. · Static position requiring abdominal activation and core stability to maintain neutral spine.	
DNS - 6 month prone with reaching	· Dynamic progression of static 6-month prone position, elevating single arm to reach forward. · Requires anterior oblique sling activation to stabilize trunk.	
DNS - 6 month prone with knee slides	· Dynamic progression of static 6-month prone position, sliding single knee towards ipsilateral elbow. · Requires anterior oblique sling activation to stabilize trunk.	

Turkish getups	· Dynamic core stabilization transitional movement. · Transition from supine to standing with arm remaining elevated throughout. · Requires oblique activation for trunk rotation, scapular stability and serratus activation to maintain scapular protraction while holding weight, and anterior oblique sling activation and core stability to maintain neutral spine throughout.	  



APPENDIX B

Table 5: Return to running protocol[15]

Running Progression

Track	
Level 1	Jog straights/Walk curves (1 mile)
Level 2	Jog straights/Jog 1 curve every other lap (1 mile)
Level 3	Jog straights/Jog 1 curve every lap (1 mile)
Level 4	Jog 1.75 lap/walk curve (1 mile)
Level 5	Jog all laps (1 mile)
Level 6	Increase workout to 1.5 miles
Level 7	Increase workout to 2 miles
Level 8	Increase speed on straights/jog curves