Case Report

Use of a Classification System to Guide Nonsurgical Management of a Patient With Chronic Low Back Pain

Background and Purpose. This case report describes the use of a classification system in the evaluation of a patient with chronic low back pain (LBP) and illustrates how this system was used to develop a management program in which the patient was instructed in symptom-reducing strategies for positioning and functional movement. **Case Description.** The patient was a 55-year-old woman with a medical diagnosis of lumbar degenerative disk and degenerative joint disease from L2 to S1. Rotation with extension of the lumbar spine was found to be consistently associated with an increase in symptoms during the examination. Instruction was provided to restrict lumbar rotation and extension during performance of daily activities. **Outcomes.** The patient completed 8 physical therapy sessions over a 3-month period. Pretreatment, posttreatment, and 3-month follow-up modified Oswestry Disability Questionnaire scores were 43%, 16%, and 12%, respectively. **Discussion.** Daily repetition of similar movements and postures may result in preferential movement of the lumbar spine in a specific direction, which then may contribute to the development, persistence, or recurrence of LBP. Research is needed to determine whether patients with LBP would benefit from training in activity modifications that are specific to the symptom-provoking movements and postures of each individual as identified through examination. [Maluf KS, Sahrmann SA, Van Dillen LR. Use of a classification system to guide nonsurgical management of a patient with chronic low back pain. *Phys Ther.* 2000;80:1097–1111.]

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Despite being one of the most commonly treated disorders in outpatient physical therapy practice,[1] the management of low back pain (LBP) continues to be a challenge. We believe that 2 issues, in particular, contribute to this challenge. The first issue relates to the lack of an accepted classification system for LBP that is feasible to use and that is validated through research. The second issue relates to the conceptual distinction between physical impairment and functional limitation, and the degree to which each is addressed in the treatment of patients with low back–related disorders.

The need to classify patients into homogenous subgroups to better facilitate the management of LBP has received much attention in recent literature.[2–15] This need is reflected by the number of classification systems that have been proposed within the past 2 decades.[2–12] Riddle[13] provided a comprehensive review of the classification systems deemed most relevant to physical therapists, along with a discussion of issues related to LBP classification. There is no consensus regarding the most appropriate classification scheme to guide the rehabilitation of patients with LBP.[14] In the view of many authors, the ability to differentiate among various subgroups of patients with LBP would enhance both the clinical management and the scientific study of LBP.[14,15]

Measures of physical impairment such as range of motion, muscle force, and endurance are routinely assessed by physical therapists, with the goal of using the data obtained with these measures to help direct the management of patients with LBP.[1,16] However, as noted by Jette,[17] several major conceptual models indicate that physical impairments reflect only one aspect of the disablement process. Several authors[17–19] have suggested that rehabilitation professionals must also consider functional limitations and disability. The terms "functional limitation" and "disability" will be considered together in this report and refer to an inability to perform the basic tasks of daily life and to fulfill one's social and occupational roles.[18] In a recent survey of patients with chronic LBP (*chronic LBP* in this study was defined as 8 or more episodes of recurrent LBP spaced at least 90 days apart within a 3-year period), difficulty performing everyday activities was the most frequently cited reason for seeking medical care.[20] However, in a national sample of over 2,300 outpatient physical therapy records, Jette et al[1] found that therapists cited independent function as a treatment goal for only 10.6% of all patients treated for LBP. Functional training was included in only 5.6% of the rehabilitation programs. A more recent study of physical therapy for LBP similarly revealed that the number of goals relating to range of motion (65%) and pain reduction (53%) outnumbered those relating to the facilitation of functional activity (20%).[21] Together, these studies suggest that physical therapists may tend to address physical impairments more readily than functional limitations in the treatment of patients with low back–related disorders.

There are potential benefits to using a classification approach to guide identification and treatment of symptom-provoking movements and postures.

Delitto[19] observed that clinicians may be more inclined to document measures of physical impairment com-

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pared with limitations of function based on the underlying assumption that correction of impairments will result in improved treatment outcomes. However, the link between physical impairment and decline in function in people with LBP remains unclear. Several research groups have failed to find an association between various impairment measures and subsequent development of LBP.[22–28] The absence of an established relationship between physical impairment and function in individuals with LBP suggests that limitations of function should be addressed directly in any therapeutic program that seeks to improve functional outcomes.

The purpose of this case report is 2-fold. First, we will describe the use of a classification system in the evaluation of a patient with chronic LBP. Second, we will demonstrate how this classification system was used to guide development of a treatment plan that included modification of symptom-producing motions and alignments of the lumbar spine during the performance of daily work, leisure, and self-care activities. In doing so, we hope to illustrate the potential benefits of using a classification approach to guide identification and treatment of the symptom-provoking movements and postures that are specific to each individual.

Conceptual Overview of LBP Classification Approach

The system of classification described in this report was designed in an effort to aid clinicians in identifying the primary movement problem toward which we believe physical therapy intervention should be directed. Therefore, each category of the classification system is named for the specific direction of spinal alignment or motion that is found to be consistently associated with an increase in LBP during testing. A summary of the signs and symptoms associated with each of the 5 categories proposed in this classification system is presented in Table 1.[12,29] The validity of data obtained with this classification system has not been demonstrated experimentally. The interrater reliability of data obtained for physical examination items used to classify patients according to this system has been reported previously (kappa≥.87 for 100% of items related to symptom production; kappa≥.42 for 72% of items related to alignment and movement signs).[12]

An underlying assumption of this approach is that the daily repetition of similar movements and postures can result in movement of the lumbar spine in a specific direction, which then may contribute to the development, persistence, or recurrence of mechanical LBP.[12] We believe that the direction of spinal motion associated with an increase in low back–related symptoms reflects movement strategies and postures that are repeated by a given individual throughout each day. For example, an avid tennis player may be inclined to develop a symptom causing predisposition for motion of the lumbar spine into a direction of extension and rotation, whereas a cyclist may be more likely to develop symptoms associated with lumbar flexion and rotation. Presumably, individuals may develop habitual movements and postures in response to functional activity demands that may contribute to LBP and that may be identified and corrected through the evaluation of alignments and motions of the lumbar spine.

To classify a patient as being in 1 of the 5 categories listed in Table 1, we believe that the clinician should attempt to identify a consistent pattern of signs

Table 1.
Mechanical Low Back Pain Classification Categories, With Associated Signs and Symptoms[29]

Category	Associated Signs and Symptom Behavior
Flexion	Tendency for the lumbar spine to move in the direction of flexion with movements of the spine and extremities. Lumbar spine alignment tends to be flexed relative to neutral[a] with the assumption of postures (ie, standing, sitting, supine, side lying, prone, quadruped). Symptoms occur or increase with the lumbar spine positioned or moved into flexion. Symptoms disappear or decrease with restriction[b] of lumbar flexion.
Extension	Signs and symptoms are similar to those described for flexion except that they occur with extension.
Rotation	Tendency for the lumbar spine to move in the direction of rotation with movements of the spine and extremities. Lumbar spine alignment tends to be rotated relative to neutral with the assumption of postures. Symptoms (often unilateral) occur or increase with the lumbar spine positioned or moved into rotation. Symptoms disappear or decrease with restriction of lumbar rotation.
Rotation with flexion	Tendency for the lumbar spine to move in the direction of rotation and flexion with movements of the spine and extremities. Lumbar spine alignment tends to be flexed and rotated relative to neutral with the assumption of postures. Symptoms (often unilateral) occur or increase with the lumbar spine positioned or moved into rotation and flexion. Symptoms disappear or decrease with restriction of lumbar rotation and flexion
Rotation with extension	Signs and symptoms are similar to those described for rotation with flexion except that they occur with rotation and extension.

[a] "Neutral" is defined as the position of the lumbar spine at which an inclinometer centered over each lumbar spinous process would result in a measure of 0 degrees, without rotation or side bending of any of the lumbar vertebrae.[12]
[b] Restriction of spinal motions and alignments is accomplished using verbal cues, active stabilization by the patient, and manual stabilization by the examiner.

(ie, direction-specific motions and alignments of the lumbar spine) and symptoms (ie, reproduction of low back–related complaints, including numbness, tingling, or pain in the back or lower extremities) in response to items performed in several different test positions (eg, standing, sitting). Due to the anatomical relationship between the spine and extremities, motions of the spine that occur during limb movement are evaluated in addition to overt spinal motions that occur during movement of the torso (eg, forward bending). Confirmation that the symptom-provoking spinal motion or alignment has been correctly identified occurs by restricting that motion or alignment and noting whether there is a reduction of symptoms (see Appendix in the full-text version of this article on the *Physical Therapy* Web site at http://www.apta.org/pt_journal).

In this system of classification, the primary direction of symptom-provoking spinal motion or alignment identified in the examination as causing symptoms is referred to as the *lumbar movement dysfunction.* We believe that once a patient has been classified according to the primary movement dysfunction, treatment strategies designed to limit direction-specific motions or alignments that increase the patient's low back–related symptoms can be implemented. We consider identification and correction of the lumbar movement dysfunction during work, leisure, and self-care activities to be a priority due to the presumed frequency with which these movements and postures are repeated throughout each day. We also believe that impairments in muscle force and joint flexibility should be addressed relative to their possible contribution to the lumbar movement dysfunction.

Case Description

Patient

The subject of this case report was a 55-year-old woman referred for physical therapy with a medical diagnosis of degenerative disk disease and degenerative joint disease of the lumbar spine. The radiography report described findings of decreased intervertebral disk space extending from L2 to S1, as well as decreased joint space and sclerotic changes in the facet joints at L2-3 and L4-5. The patient reported a 40-year history of recurrent LBP, with multiple episodes each year, and symptoms that typically persisted less than a week before resolving spontaneously. Previous management for the patient's current episode of LBP included approximately 12 physical therapy sessions at an unrelated facility. The patient reported these sessions to be marginally effective in reducing her low back–related symptoms at the time of treatment, with an exacerbation of symptoms occurring within 2 weeks of her final visit to that facility.

The patient's self-reported medical history included bladder neck suspension surgery performed in 1991 for the treatment of urinary incontinence, along with a history of cigarette smoking and high blood pressure. Medications included calcium supplements, Wellbutrin* (prescribed as an antidepressive agent), Premarin† (prescribed as a cholesterol-lowering agent), cyclobenzaprine (prescribed as a muscle relaxant), and ibuprofen. The patient reported taking the latter 2 medications infrequently for the relief of severe low back–related symptoms. The patient was self-employed as an insurance agent and worked approximately 40 hours per week from her home office. We were aware of no change in the patient's medications or employment during the course of treatment or during the 3-month follow-up period.

The symptoms for which the patient sought intervention began approximately 10 weeks prior to her first visit to our facility. Symptoms that persist for this duration are considered to be of a chronic nature by the Quebec Task Force for Spinal Disorders.[30] The patient reported that she had a constant ache across the central low back that fluctuated throughout the day. The average intensity of her symptoms was 6 on a verbal pain scale ranging from 0 to 10. The 11-point numeric rating scale of average pain intensity has been found to yield reliable measurements[31] and to be related to other measures of pain intensity when used by patients with LBP.[32] She was told that a rating of 0 should represent the absence of pain and a rating of 10 was the worst pain imaginable. The patient also noted an intermittent stabbing pain along her left posterior thigh and calf, which she said was exacerbated by twisting motions of the trunk. A tingling sensation was occasionally present in the left toes. The patient reported that the onset of her symptoms occurred after walking at a slow pace on a treadmill in her home for several minutes. The patient described herself as inactive, and she said that she had attempted to begin walking to help lose weight. She reported a gradual worsening of symptoms in the first few days after walking on her treadmill, with no notable improvement or decline of symptoms in subsequent weeks. She described having particular difficulty performing the following activities due to increased low back–related symptoms: brushing her teeth, rolling toward her left side, loading the dishwasher, getting into and out of her truck, and walking long distances, such as when grocery shopping.

The patient described in this case report was part of an ongoing clinical study of the effects of modifying

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† Wyeth-Ayerst Pharmaceuticals, Div of American Home Products Corp, PO Box 8299, Philadelphia, PA 19101.

symptom-producing movements and postures during a physical examination being conducted by the third author. The patient was recruited from 1 of 6 outpatient physical therapy clinics participating in a previous study by our group.[12] With the exception of a notably higher Oswestry Disability Questionnaire[33] score (43% versus 24%), this patient exhibited characteristics similar to the patient population described in a previous report on the interrater reliability of data obtained by examiners administering physical examination items used in the classification of mechanical LBP.[12]

Examination

To classify the patient's lumbar movement dysfunction according to the system described above, the first author conducted posture and movement testing with the patient in the following positions: standing, sitting, supine, side lying, prone, and quadruped. The first author had limited experience (<6 months) with the proposed system of classification prior to receiving training, which was similar to that received by therapists participating in a previous study.[12] Briefly, training consisted of 5 individualized instruction sessions of 45 minutes to 1 hour duration with therapists having documented experience in the proposed classification system[12] and completion of a written examination on the content of a reference manual containing operational definitions of terms and standardized clinical examination procedures.

The patient's self-selected movement strategy or posture was assessed for signs of movement dysfunction during performance of each test item. Prior to each test, the patient assumed a reference position in which the intensity and location of the low back–related symptoms were assessed. For tests of alignment, the patient was asked to assume the test position for at least 10 seconds before noting any change in symptoms relative to symptoms in the reference position. For active movement tests, the patient was asked to indicate the point in the range of trunk or limb movement at which a change in symptoms occurred relative to symptoms in the reference position. The patient indicated whether the symptoms increased, decreased, or remained the same with each new position or movement, and descriptions of symptoms were noted. Any test that elicited an increase in the patient's symptoms was repeated, but was modified in an attempt to alleviate the symptoms. Modification of each test item involved restriction of the specific spinal motion or alignment that was observed during performance of the initial, symptom-provoking test. Restriction of symptom-producing spinal motions and alignments was accomplished using verbal cues, active stabilization by the patient, and manual stabilization by the examiner. Following each modified test item, the patient again was asked to indicate the status of her symptoms. Procedures used in the examination of motions and alignments of the lumbar spine are described in further detail in the Appendix (shown in the full-text version of this article on the *Physical Therapy* Web site at http://www.apta.org/pt_journal). Findings from the examination of the patient are presented in Table 2.[12,30]

Active control of the alignment of the lumbar spine was facilitated by verbally and/or manually cueing the patient to contract her abdominal muscles just prior to and throughout the attainment of each modified test position or movement. She had difficulty using her abdominal muscles and often held her breath, which we presumed was to compensate for a lack of muscular control. Successful attempts at using the abdominal muscles, as identified through palpation, frequently resulted in complaints of cramping and pain localized to the pelvic region. The patient indicated that she had been experiencing such symptoms regularly in the 8 years since her bladder neck suspension surgery. The intensity of these symptoms could be reduced or eliminated by instructing the patient to reduce the effort of abdominal muscle contraction.

The first author also examined muscle force and joint flexibility to determine which physical impairments might contribute to the observed tendency for direction-specific motions and alignments of the lumbar spine. Pretreatment and posttreatment impairment measurements are summarized in Table 3.[29,34–38] The patient displayed no signs of neurological deficit, as assessed by light touch sensation and manual muscle testing of L1-S1 myotomes.[39] The straight-leg-raising test[39] was negative for signs of neural tension. Results of testing for nonorganic signs of magnified illness behavior as described by Waddell et al[40] also were negative. Neurologic and Waddell tests were used to identify the presence of nerve impairment and to rule out magnified illness behavior. Results were not used in classification of the patient's primary movement dysfunction.

The examiner believed that substitution using the hip flexors occurred during manual muscle testing of several lower-extremity muscle groups (Tab. 3). Hip flexor substitution was thought to be present when the extremity being examined moved from the desired manual muscle test position into a position of increased hip flexion. Excessive use of the hip flexors also was observed throughout the examination as the patient moved in her accustomed manner. For example, the patient's self-selected strategy for moving from a sitting position to a supine position was first to assume a long-sitting position and then to lower her upper body toward the support surface using no upper extremity assistance. This method, which presumably required eccentric contraction of the hip flexor muscles, was associated with an

Table 2.
Findings From Examination of Alignments and Movements of the Lumbar Spine[a]

Test Item	Test Response With Self-Selected Alignments and Movements[b]	Test Response With Modified Alignments and Movements
Standing forward bending	No change in status of symptoms	
Return from forward bending	Large excursion into spinal extension prior to onset of hip extension (eg, return to upright position accomplished by leading with back rather than hips) ↑[c] in intensity of central LB[d] sxs	No signs of spinal extension Central LB sxs eliminated[c]
Standing lumbar extension	Lumbar extension ↑ in intensity of central LB sxs	No modified test
Side bending	Rotation of pelvis and lumbar spine in the horizontal plane when side bending toward left ↑ in intensity of central LB sxs	No signs of pelvic or lumbar rotation Central LB sxs eliminated
Sitting	Preferred position with lumbar spine aligned in extension and lateral side bend relative to neutral[e] ↓[c] in intensity of central LB sxs (relative to weight-bearing position in which lumbar spine was similarly aligned in extension)	
Sitting with lumbar spine flexed	No change in symptoms	
Sitting with lumbar spine extended	No change in symptoms	
Sitting active knee extension	No change in symptoms	
Supine hips and knees flexed	No change in symptoms	
Supine passive double knees to chest	No change in symptoms	
Supine hips and knees extended	No change in symptoms	
Supine active single knee to chest	Lumbar extension with initiation of right LE movement CW pelvic rotation with initiation of right LE movement ↑ in intensity of central LB sxs with initiation of right LE movement ↓ in intensity of central LB sxs during late phase of right LE movement as knee moved closer toward chest, reducing amount of lumbar extension	No signs of lumbar extension or pelvic rotation Central LB sxs eliminated
Supine active hip abduction and lateral rotation	No change in symptoms	
Side lying	Preferred position with hips and knees flexed >90° and lumbar spine aligned in flexion relative to neutral ↓ in intensity of central LB sxs	

increase in LBP. The patient also exhibited a habit that she referred to as "nervous legs," characterized by rapid bouncing movements of the lower extremities, apparently initiated at the hip. This habit was observed intermittently throughout the examination, most often when the patient was sitting or lying supine.

Classification and Intervention

Based on the signs and symptoms noted during the examination, we believed that the patient's primary movement dysfunction was lumbar rotation with extension (Tab. 4). We viewed decreased hip flexor length and excessive use of the hip flexor muscles during the performance of routine activities as impairments having the potential to contribute to rotation and extension of the lumbar spine with static postures and active movements of the spine and extremities. Our goal was to improve the patient's ability to perform functional activities, while minimizing the symptoms associated with rotation and extension of the lumbar spine.

During her initial visit, the patient was given instructions for activity modification based on the category to which she was assigned. The recommended strategies for activity modification are summarized in Table 5.[12] A feature common to each of these strategies was the specific

Table 2.
Continued

Test Item	Test Response With Self-Selected Alignments and Movements[b]	Test Response With Modified Alignments and Movements
Prone	Lumbar extension ↑ in intensity of central LB sxs	No signs of lumbar extension ↓ in intensity of central LB sxs
Prone active knee flexion	No change in status of symptoms	
Prone active hip rotation	Lumbar extension and CCW pelvic rotation during movement of left hip into lateral rotation Change in location of sxs from central LB, to central LB and left posterior thigh	No signs of lumbar extension or pelvic rotation Left posterior thigh sxs eliminated No change in intensity of central LB sxs
Prone active hip extension	Lumbar extension and CCW pelvic rotation during left hip extension Lumbar extension and CW pelvic rotation during right hip extension Change in location of sxs from central LB in prone, to central LB and left posterior thigh during extension of each hip	No signs of lumbar extension or pelvic rotation with modified test for left and right hip extension Left posterior thigh and central LB sxs eliminated with modified test for left and right hip extension
Quadruped	Preferred position with lumbar spine aligned in extension and lateral side bend relative to neutral ↑ in intensity of central LB sxs	No signs of lumbar extension or lateral side bending Central LB sxs eliminated
Quadruped active arm lift	No change in symptoms	
Quadruped rocking backward	No change in symptoms	
Quadruped rocking backward in full flexion	No change in symptoms	
Quadruped rocking forward	No change in symptoms	

[a] Signs of direction-specific alignment or movement of the lumbar spine were recorded and modified only when associated with an *increase* in the patient's symptoms. Modification of each test item (third column) was accomplished with verbal cues, active stabilization by the patient, and manual stabilization by the examiner to specifically restrict the symptom-related alignments or motions (second column) listed for each item. A complete description of each test item is provided in the Appendix. Abbreviations: ↑=increase, ↓=decrease, LB=low back, sxs=symptoms, LE=lower extremity, CCW=counterclockwise (ie, forward rotation of the right hip with backward rotation of the left hip), CW=clockwise (backward rotation of the right hip with forward rotation of the left hip).
[b] "Self-selected alignments and movements" refers to alignments and movements of the lumbar spine that are observed when the patient initially assumes a test position (eg, sitting) or performs a test movement (eg, forward bending) using his or her preferred movement strategy with no further instruction from the examiner.
[c] An "increase" in symptoms is defined as pain or paresthesias that were either produced, increased in intensity, or moved distally from the lumbar spine with assumption of a test position or performance of a test movement. A "decrease" in symptoms is defined as pain or paresthesias that either diminished in intensity or moved proximally toward the lumbar spine with assumption of a test position or performance of a test movement. "Eliminated" is defined as the absence of symptoms that were present during assumption of a previous test position or performance of a previous test movement.
[d] "Central LB" refers to the region surrounding the spine extending from T12 to the gluteal fold.[29]
[e] "Neutral" is defined as that position of the lumbar spine at which an inclinometer centered over each lumbar spinous process would result in a measure of 0 degrees, without rotation or side bending of any of the lumbar vertebrae.[12]

discouragement of rotation and extension of the lumbar spine during daily activities. Along with addressing the activities that the patient identified as problematic, other tasks commonly associated with rotation and extension of the lumbar spine, such as reaching overhead or across the body, also were addressed (Tab. 5).

During subsequent visits, the patient was instructed in a home exercise program to address both functional limitations and specific physical impairments. The patient was encouraged to practice isolated limb movements while avoiding rotation or extension movements of the lumbar spine. This was accomplished through performance of the modified version of each movement test that resulted in symptoms during examination (Tab. 2), as described in the Appendix (shown in the full-text version of this article on the *Physical Therapy* Web site at http://www.apta.org/pt_journal). The importance of activity modification was emphasized by having the patient perform the majority of exercises both in isolation and during functional movement. For example, the patient was instructed to perform 10 to 15 daily repeti-

Table 3.
Pretreatment and Posttreatment Physical Impairment Measurements[a]

	Pretreatment	Posttreatment
Lumbar spine excursion range of motion (ROM) (°)[b]		
Flexion	30°	80°
Extension	8°	45°
Side bend right	34°	31°
Side bend left	32°	24°
Muscle length (°) as indicated by ROM[c]		
Hamstrings (R/L)	70/78	76/67
Latissimus dorsi (R/L)	151/145	163/145
Hip flexors (R/L)[d]	−30/−20	0/−10
Muscle force[e]		
Hip medial rotators (R/L)[c]	4+/4−	4+/4
Tensor fascia lata (R/L)[c]	3/3+	3/3+
Gluteus medius (R/L)[c]	3/4	3+/3+
Lower abdominals[f]	NT	2

[a] Flexibility and force tests performed for all major lower-extremity muscle groups. Measurements listed only for those tests that revealed limitations. Twelve-week time interval between pretreatment and posttreatment measurements.
[b] Spinal range-of-motion measurements reflect excursion of the lumbar spine from a position of upright standing and were obtained using the 2-inclinometer method with landmarks over the L1 and S2 spinous processes. Intrarater reliability for 3 examiners measuring 15 patients with low back pain has been reported to range from r=.13 to r=.85.[34]
[c] Tests performed as described by Kendall et al.[35] R=right, L=left. The average intrarater reliability for 4 examiners performing upper- and lower-extremity goniometric measurements on 12 male subjects without impairments has been reported to be r=.85.[36]
[d] The average intraclass correlation coefficient for indexing intrarater reliability for 2 examiners performing a modified version of the hip flexor length test as described by Kendall et al[35] on 10 subjects without impairments has been reported to be .82.[37]
[e] Muscle force grades were assigned using a modified Medical Research Council (MRC) grading scale,[38] with grades ranging from 0 to 5. Weighted kappa values to index the intrarater reliability for 4 examiners performing testing of proximal lower-extremity muscle groups according to the MRC scale in 102 patients with Duchenne muscular dystrophy ranged between .71 and .93.[38] Substitution of hip flexors noted on testing of hip medial rotator, tensor fascia lata, and gluteus medius muscles at pretreatment assessment only. (Note: all substitutions were corrected prior to assigning a manual muscle test grade.)
[f] Lower abdominal muscle force test performed as described by Sahrmann.[29] NT=not able to test because of pain.

Table 4.
Test Items for Which Patient's Symptoms Were Decreased or Eliminated With Restriction of Spinal Alignment or Movement[a]

Flexion	Extension	Rotation	Rotation With Flexion	Rotation With Extension
No lumbar flexion associated with an increase in symptoms	Return from forward bending Prone	Side bending (left)	No lumbar flexion with rotation associated with an increase in symptoms	Supine active single knee to chest (right) Active hip lateral rotation (left) Active hip extension (bilateral) Quadruped

[a] Test items listed according to the specific direction of spinal alignment or movement that was restricted during performance of the modified test for each item (see Tab. 2). Classification is determined based on the category having the majority of test items in which symptoms are increased. Priority in determining the low pack pain classification category is given to those tests in which the examiner is able to decrease or eliminate symptoms by restricting the specific direction of spinal motion or alignment found to be associated with an increase in symptoms during the initial test.

tions of the forward bend exercise (Tab. 5), with additional instructions to use this same technique each time she bent forward throughout the day, such as when brushing her teeth. A brief description of each exercise and its functional correlate is provided in Table 5. The importance of maintaining a neutral or slightly flexed position of the lumbar spine through active use of abdominal muscles was emphasized. We believed that this position would prevent an increase in low back–related symptoms and facilitate strengthening of the abdominal muscles.

In addition to the exercise program, the patient was instructed in techniques that we believed would lengthen the hip flexors and improve gluteus medius muscle force production. While lying prone, the patient used a sheet positioned around her ankle to assist in passively flexing her knee to the point at which she perceived a gentle stretch in the anterior thigh. To avoid an increase in symptoms when positioned prone, the patient initially was instructed to position 2 pillows under her abdomen, but eventually was able to perform this stretch in the absence of pillows without an increase in LBP. In an effort to improve gluteus medius muscle

force, the patient was instructed in active hip lateral rotation and abduction performed while side lying. As with all other exercises, rotation and extension movements of the lumbar spine were specifically discouraged during the performance of these 2 exercises. Following instruction in gait modifications that we believed would reduce the magnitude of rotation of the pelvis and lumbar spine (Tab. 5), a walking program was prescribed to improve aerobic fitness. The patient reported that modifying her gait reduced her symptoms immediately following instruction. The patient declined referral to a urogynecologist regarding her symptoms of pelvic pain and cramping.

Outcomes

The patient completed 8 physical therapy sessions over a 3-month period. The first 3 sessions were spaced 1 week apart, with subsequent sessions once every 1 to 4 weeks. Her condition was assessed 3 months after discharge through a telephone interview and a mailed questionnaire. A modified Oswestry Disability Questionnaire[33] and a pain diagram were used to document patient-perceived progress once each month, with 1 exception due to an administrative oversight. Patient scores on the Oswestry Disability Questionnaire have been found to be reliable (Pearson r and intraclass correlation coefficients $>.90$)[33,41] as well as related to scores on other accepted measures of disability in patients with LBP,[42] an indication of construct validity of the questionnaire. Reproducibility of pain diagram responses in patients with chronic LBP has been documented.[43] Concordance between defined disorders associated with LBP and diagnoses based on pain diagram responses provides evidence of validity of the pain diagram as a clinical tool.[44] Physical impairment measurements were obtained by the first author during the patient's final therapy session for comparison with initial values.

During her initial visit, the patient received instruction in activity modification only. In the week following this visit, the patient noted a reduction in both the frequency and intensity of her symptoms. She reported a 75% decrease in the frequency of pain in the central low back region and a 40% reduction in the frequency of symptoms in the left lower extremity. She also reported that the average intensity of her symptoms was reduced from 6/10 to 3.5/10 on a verbal pain scale, with no symptoms present the day of her second session. When asked to describe her activities during the past week, the patient noted a substantial improvement in her ability to perform household chores and in her overall tolerance for physical activity. With the exception of sit-to-supine transfers, we observed adherence to all activity modifications taught in the initial therapy session throughout the second treatment session.

By her final therapy session, the patient no longer experienced lower-extremity symptoms. She noted symptoms localized to the central low back as typically being less than 3/10 when present, with approximately 75% to 80% of her week being symptom-free. She noted that the intensity of symptoms in the central low back region generally increased with increasing fatigue. The patient was able to independently demonstrate all prescribed exercises and activity modifications as instructed, without an increase in symptoms. She reported that she typically performed her home exercise program once daily, and was walking 3.5 to 4.5 minutes each day on her treadmill without an increase in low back–related symptoms.

The modified Oswestry Disability Questionnaire[33] contains items pertaining to both functional limitation and disability and was used in this case to document functional progress. The patient's pretreatment Oswestry score of 43% dropped to 16% by her final therapy session. As interpreted by Fairbank et al,[41] these scores reflect a transition in function from severe disability to minimal disability. In the 3 months following discharge from outpatient physical therapy, the patient did not experience an exacerbation of low back–related symptoms and continued to make functional improvements. Specific examples of functional improvement noted by the patient during the follow-up telephone interview at 3 months included the ability to brush her teeth, get into and out of her truck, and shop for over an hour without an increase in symptoms.

Less consistent changes were observed for measures of muscle force and joint flexibility (Tab. 3). Changes included what we believed to be indicators of increased length of the hip flexors, improved ability to use the abdominal muscles without an increase in pain, and an increase in spinal flexion and extension range of motion. Hamstring muscle flexibility and spinal side-bending range of motion declined over the course of treatment. Estimates of the intrarater reliability of data obtained for these physical impairment measures are provided in Table 3 to the extent that this information is available. However, due to the general lack of documented reliability for many of the physical impairment measures routinely used by clinicians, small changes in the measurements should be interpreted with caution.

Discussion

Numerous interventions are available for patients with low back–related disorders.[45] The challenge for physical therapists is to identify the most appropriate intervention for each patient, based on the findings from a standardized examination. This task is difficult because the etiology of LBP is unknown in the majority of cases[45]

Table 5.
Category-Specific Treatment Plan[a]

Activity	Functional Instruction[b]		Exercise Instruction[c]	
	Do:	Do Not:	Initial:	Progression:
Forward bending/return from forward bending (eg, brushing teeth, washing dishes)	Contract abdominals to support spine in neutral[d] or slightly flexed alignment Flex at hip joints and maintain neutral alignment of lumbar spine while bending forward Extend at hip joints and maintain neutral alignment of lumbar spine while returning to the upright position	Arch LB when returning to the upright position	Same as modified forward bending/return from forward bending (see Appendix for patient position and instructions) (2)	Same as modified forward bending/return from forward bending without use of arms to support weight of upper both (3)
Supine ⇔ sit transfers and rolling	1. Bend knees by sliding 1 heel at a time toward body. Gently dig heel into support surface while sliding leg. Contract abdominals to support spine so that LB maintains contact with support surface throughout leg movement. Avoid arching LB with leg movement. 2. Roll onto side moving the entire body as a single unit. Avoid twisting. Use arms to push to upright sitting as legs drop over side of support surface at the same time. Reverse the technique to perform sit ⇒ supine transfers.	Move directly from supine to long-sitting by flexing at hip joints Lift both legs simultaneously from support surface Arch or twist LB when moving legs Use lumbar roll when sitting	Same as step 1 for supine ⇒ sit transfers Perform with 2 pillows placed under knee of stationary limb to help maintain pelvic and lumbar alignment (2)	Same as step 1 for supine ⇒ sit transfers Perform without pillows (3)
Vehicle transfers	Sit on edge of seat facing door and scoot as far back as possible, then pivot to face forward while using arms to help lift legs into vehicle	Twist trunk while getting into and out of vehicle		
Walking	Keep hips as level as possible Take smaller steps and reduce amplitude of arm swing to help avoid excessive twisting of pelvis Take frequent short breaks if walking long distances Move feet to turn body rather than twisting trunk		Single-limb stance: While standing on 1 leg, contract buttocks to maintain level pelvis and avoid bending trunk to either side Hold onto high counter or chair back to assist with balance Perform in front of mirror to monitor performance (3)	Single-limb stance: While standing on 1 leg, contract buttocks to maintain level pelvis and avoid bending trunk to either side Perform without support of arms (5)

Table 5.
Continued

Activity	Functional Instruction[b]		Exercise Instruction[c]	
	Do:	Do Not:	Initial:	Progression:
Overhead and cross-body reaching (eg, reaching for items located in overhead cabinets, reaching for items not directly in front of body, raising arms overhead to don/doff shirt, raising arms to wash or style hair)	Contract abdominals to support spine in neutral alignment when moving arms Whenever possible, stand directly in front of an item before reaching	Arch LB when reaching overhead Twist LB when reaching across body	1. While sitting in a straight-back chair, with LB supported, begin with shoulders and elbows bent to 90°, palms facing toward you and elbows facing forward. Raise both arms overhead while contracting abdominals so that LB maintains contact with support surface during arm motion. (3) 2. While sitting in a straight-back chair, with LB supported, begin with 1 arm overhead, holding a 0.9-kg (2-lb) weight. Lower arm down across body toward opposite hip. Contract abdominals so that LB and pelvis maintain contact with support surface. (6)	Perform exercise 1 while standing, with LB supported against a wall and pelvis tilted posteriorly (4) Perform exercise 2 while standing, with LB supported against a wall, and pelvis tilted posteriorly (7)
Sitting	Sit with LB either in neutral or slightly flexed alignment Use the chair back for support Support feet while sitting. Relax legs and let chair support the weight of thighs. Cross legs at ankles rather than at thighs to avoid pelvic rotation Take frequent breaks by standing up or performing a "push-up" from chair (ie, push down on arm rests to lift buttocks from chair seat)	Sit forward on edge of chair or place a lumbar roll behind LB Bounce legs repeatedly while sitting or let legs dangle unsupported	Posterior pelvic tilts while seated (2)	

[a] The patient was instructed to incorporate techniques for functional activity modification into performance of daily activities. In addition to exercises listed in table, the home exercise program (HEP) included performance of the modified version of each symptom-provoking movement test described in Table 2, as well as exercises to lengthen the hip flexors and improve gluteus medius muscle strength. The patient was initially instructed to perform 6 to 8 repetitions of each exercise, 2 to 3 times daily (with the exception of hip flexor stretch, which was performed twice daily for 3 to 5 repetitions, lasting 30 seconds each). Intermittent performance of a relatively low number of repetitions was chosen in order to avoid muscle fatigue and to optimize motor learning through random practice sessions. As the patient's endurance improved, the number of repetitions for each exercise was increased to 10 to 15 repetitions per session. A walking program was initiated in the third therapy session. LB=low back.

[b] All functional instructions were provided during initial visit and were reviewed periodically across the 8 treatment sessions.

[c] Number in parentheses indicate at which visit the patient received instruction in each exercise (8 visits total). In general, exercises were progressed when the patient was able to perform at least 10 to 15 repetitions of initial exercise without verbal or manual cues from the therapist. In no case was an exercise progressed if the patient was unable to demonstrate the modified exercise as instructed and without an increase in symptoms. Upon discharge, the patient was encouraged to adhere to functional activity modifications indefinitely to prevent a recurrence of symptoms. We also suggested that she remain physically active by continuing her HEP and walking program at least once daily.

[d] "Neutral" is defined as that position of the lumbar spine at which an inclinometer centered over each lumbar spinous progress would result in a measure of 0 degrees, without rotation or side bending of any of the lumbar vertebrae.[12]

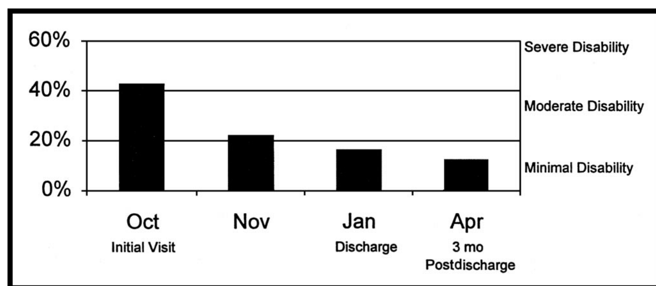

Figure.
Modified Oswestry Disability Questionnaire[33,41] scores reported by patient across study period.

and the relationship between physical impairment and disability in this population remains largely undefined.[19]

Our case report describes an intervention that was chosen based on the evaluation of spinal alignment with postures and spinal motions during active movement of both the spine and extremities. Given the documented lack of association between LBP and various traditional measures of physical impairment,[23] we sought to identify a particular pattern of spinal motions and alignments that appeared to be directly associated with a worsening of symptoms across several test positions. We then based intervention on modification of symptom-producing motions and alignments of the lumbar spine during the repetition of daily activities. Despite modest changes in measures of physical impairment (Tab. 3), the patient described in this case report exhibited what we consider a substantial and consistent reduction in low back–related functional limitations and disability (Figure) over the course of treatment. In addition, the most dramatic reduction in low back–related symptoms occurred following the first therapy session, in which the only treatment provided was category-specific instruction in activity modification.

Waddell et al[46] found a strong association between low back–related disability and fear-avoidance beliefs, or the extent to which patients avoid activity based on the anticipation of pain. Waddell et al suggested that restricting the activity of patients with LBP might serve only to reinforce fear-avoidance beliefs and increase the chances of subsequent disability. The benefits of maintaining customary activity levels in patients with LBP has been substantiated by the findings of Malmivaara et al.[47] These investigators found that subjects with LBP who were advised to continue their usual routine as tolerated recovered more quickly than those who were prescribed either 2 days of complete bed rest or back mobilizing exercises.

Teaching patients *specific* strategies to reduce the symptoms associated with movements can enable them to perform activities that they might otherwise avoid. We believe that one of the primary advantages of the classification system described in this case report is that it allows physical therapists to make recommendations for activity modification that are specific to the symptom-provoking postures and movements of each patient. We propose that exercise prescription and generic postural instruction may be less effective in addressing restrictions of function in patients with LBP than is individualized instruction in symptom-reducing strategies for positioning and functional movement. The patient described in this report, for example, was instructed in ways to avoid rotation and extension of the lumbar spine during daily activities. The use of a lumbar roll is one example of a generic therapeutic modality that was discouraged in this case because it would have contributed to spinal extension, an alignment found to be associated with an increase in this patient's symptoms. Greater individualization of back care programs may be needed to facilitate patient adherence.[21] The patient described in this case report noted the greatest adherence to exercises and activity modifications that could be easily incorporated into her daily routine, such as those related to forward bending, walking, and sitting up in bed (Tab. 5).

The treatment approach described in this case report is founded on the notion that the repetition of direction-specific movements and postures of the lumbar spine can exacerbate low back–related symptoms and prolong recovery. The patient exhibited a consistent tendency toward lumbar rotation and extension, which was observed during examination of movements and postures across several positions as well as during the performance of functional tasks (eg, sit-to-supine transfers) and personal habits (eg, "nervous legs"). We have observed that the propensity for spinal motion to occur in a given direction varies among individuals, and we speculate that this variation may be partly related to individual variations in motor recruitment patterns. This idea is consistent with reports of high intersubject variability in trunk muscle activity patterns during a given movement.[48,49] Based on the results of an investigation into the effects of fatigue on trunk motion, Parnianpour et al[50] suggested that the loss of muscular coordination associated with fatigue may diminish spinal stability and allow loading of the spine in a more injury-prone pattern. The patient in this case report commented that she found it more difficult to control the position of her spine and pelvis when she was tired, and she associated an increase in her symptoms with fatigue.

We also have observed that variations in occupational and recreational activity demands appear to contribute to individual differences in direction-specific motions and alignments of the lumbar spine. We suggest that this may be related to changes in supportive structures of the

spine that occur with repeated stresses in a given direction over time. A relationship between repetitive spinal motion and LBP is suggested by epidemiologic studies that have identified repetition of non-neutral trunk postures as a risk factor for the development of LBP.[51] In addition, Gordon et al[52] have shown that repetitive loading of spinal segments positioned in a slight amount of flexion and rotation results in pathological changes in the intervertebral disk of the in vitro human spine.

Causal relationships cannot be established on the basis of a case report. Symptoms associated with disorders of the low back typically resolve within 6 weeks of onset, and only 5% of individuals have symptoms that persist longer than 3 months.[51] The LBP episode described in this case report began 10 weeks prior to the patient's initial therapy visit to our facility, which is beyond the time frame typically associated with natural resolution of LBP. Improvement in both functional ability and symptom reduction coincided with the initiation of treatment at our facility. The patient did not experience a recurrence of low back–related symptoms in the 3 months following discharge from our clinic, during which time she continued her home exercise program and activity modifications. Together, these observations suggest that our approach may have positively influenced the patient's recovery. This does not, however, rule out the possibility that the patient might have recovered spontaneously, or responded equally well to another therapeutic approach.

In any isolated case, there are several factors other than the intervention that might account for the observed outcomes. Aerobic training has been reported to be of benefit in the treatment of many disorders, including those related to the low back.[53] Based on reports of the efficacy of aerobic training, a walking program was prescribed during the third treatment session. It seems unlikely that the observed outcomes can be attributed to an improvement in aerobic conditioning, however, given that the patient remained unable to ambulate for more than 5 minutes at one time without becoming short of breath. It might be argued that improvements in hip flexor muscle length could be largely responsible for helping to reduce the patient's symptoms, as lower-extremity flexibility is a commonly addressed impairment in the treatment of LBP. To our knowledge, however, prospective studies have failed to demonstrate a consistent correlation between LBP and hip flexor tightness.[27,54] Because the psoas major muscle is known to impart substantial compressive forces on the lumbar spine,[55] it is conceivable that discouraging the active recruitment of this muscle may have influenced the observed outcome.

Further research is needed to determine the validity and clinical feasibility of the system of classification described in this case report. The theoretical assumptions on which the approach was founded should be investigated to determine construct validity. For instance, is it true that the lumbar spine can become predisposed to excessive movement in a given direction when subjected to repeated stresses in that direction? Examination of whether the proposed classification categories are mutually exclusive and appropriate for use in a rehabilitation context will be necessary to establish content validity. For example, can any patient referred to a physical therapist for the treatment of LBP be classified into 1 of the 5 proposed categories, or does this classification system describe a more limited patient population, such as those with chronic LBP? If the predictive validity of this system could be appropriately demonstrated, then we believe physical therapists could make a substantial contribution to preventative health care. Individuals could be screened for patterns of spinal motion and alignment that may increase the risk of developing mechanical LBP, and they could be provided with specific instruction regarding the modification of such patterns. Other areas of future research should include controlled clinical trials to establish the relative efficacy of individualized versus generic functional instruction, as well as to determine the optimal approach for improving rehabilitation outcomes for patients with LBP.

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