We present the movement control approach as part of the treatment-based classification system. This approach proposes a movement control schema that clarifies that movement control is a product of the interplay among multiple biopsychosocial components. The schema illustrates that for movement to occur in a dynamically controlled fashion, the lumbar spine requires both local mobility and global stability. Local mobility means that the lumbar spine and its adjacent regions possess adequate nerve and joint(s) mobility and soft tissue compliance (ie, the malleability of tissue to undergo elastic deformation). Global stability means that the muscles of the lumbar spine and its adjacent regions can generate activation that is coordinated with various joint movements and incorporated into activities of daily living. Local mobility and global stability are housed within the bio-behavioral and socio-occupational factors that should be addressed during movement rehabilitation. This schema is converted into a practical physical examination to help the rehabilitation provider to construct a clinical rationale as to why the movement impairment(s) exist. The examination findings are used to guide treatment. We suggest a treatment prioritization that aims to consecutively address neural sensitivity, joint(s) and soft tissue mobility, motor control, and endurance. This prioritization enables rehabilitation providers to better plan the intervention according to each patient’s needs. We emphasize that treatment for patients with low back pain is not a static process. Rather, the treatment is a fluid process that changes as the clinical status of the patient changes. This movement control approach is based on clinical experience and indirect evidence; further research is needed to support its clinical utility.
Clinical Challenges With the Spine Stability Model

The Panjabi stability model postulates that injury in the passive subsystem (ie, non-contractile structures) may lead to immediate compensation by the active subsystem (ie, contractile structures). This immediate compensation allows the spine to continue to function normally through appropriate changes in muscle activity. However, the muscles sometimes fail to compensate appropriately, which may lead to spinal dysfunction (ie, instability), resulting in conditions such as LBP.

While it remains unknown whether muscle-related spinal dysfunction is a cause or consequence of LBP, identifying such dysfunction clinically was attempted using a number of tests including, but not limited to, observation of aberrant motion and the prone instability test. These tests are selected as a proxy to identifying muscle-related spine dysfunction. If aberrant motion is observed, it suggests that the muscles of the torso are unable to control the motion. If the prone instability test produces pain when the spine is passively provoked but the pain disappears when the spinal extensors are active, then increasing muscle activation might be beneficial. When such tests are positive, the patient is said to lack sufficient neuromuscular performance (ie, motor control, endurance, and strength). As such, the Panjabi stability model promoted the idea that lack of neuromuscular performance may lead to LBP and that muscle compensation may be required to remedyl the spinal dysfunction.

Based on the stability model, clinicians and researchers started to theorize about how to regain spinal stability via improving neuromuscular performance. This generated a cascade of studies that investigated the differences in neuromuscular performance between patients with LBP and healthy controls. Some of this research revealed that neuromuscular performance characteristics were deficient in patients with LBP compared to healthy controls. This prompted the rehabilitation community to propose stabilization exercise programs aimed at remedying these neuromuscular deficiencies. It was hoped that stabilization exercises would "re-stabilize" the spine, prevent repetitive attacks of LBP, and subsequently improve overall lumbar spine movement. However, over the past 20 years of research, stabilization exercises have not been shown to result in clinically meaningful improvements in pain, function, or lumbar spine movement.

While the stability model helped to clarify that sufficient neuromuscular performance was an essential requirement for spinal movement, in our opinion, rehabilitation providers placed too much emphasis on neuromuscular performance and neglected other necessary components for lumbar movement, such as the viscoelastic properties of the soft tissues and the osteoligamentous spine itself. These viscoelastic properties represent a feedback mechanism that facilitates dynamic control of the spine via sendingafferent proprioceptive signals about the length of the soft tissues and their rate of lengthening. However, by only addressing neuromuscular performance, rehabilitation providers were centering their interest solely on static stability and unknowingly disregarding the need for dynamic stability in lumbar movement.

In our view, the dynamic stability concept of the lumbar spine has not been fully incorporated into lumbar rehabilitation protocols, despite the fact that correct posture/alignment, appropriate soft tissue properties, and intact neural mobility have always been implied as part of the spinal rehabilitation process. We think that this situation calls for a more encompassing model that accounts for all aspects necessary for improving human movement characteristics.

The Movement Control Schema

In this text and elsewhere, movement control is achieved with proper interaction of 6 components (Fig. 2). The 6 components can be divided into local mobility and global stability (Fig. 3). Local mobility means that the
The symptom modulation approach deals with patients whose spinal movement is hindered primarily by significant pain and symptomatic features. The goal of this approach is to control the noxious pain generator(s) and its sequelae that interfere with lumbar movement.

The movement control approach, which is the focus of this paper, deals with patients whose spinal movement is hindered more by dysfunctional joint and soft tissue compliance and neuromuscular control. The goal of this approach is to improve joint and soft tissue compliance, and to integrate that with appropriate neuromuscular control in order to improve the quality of the lumbar movement.

The functional optimization approach focuses on patients whose movement is hindered by muscle deconditioning and fatigue. The goal of this approach is to improve the lumbar spine capability to withstand higher levels of physical performance.
The lumbar spine along with its adjacent regions should independently possess adequate neural and joint mobility and soft tissue compliance (i.e., malleability of soft tissue to undergo elastic deformation). Global stability means that the muscles of the lumbar spine and in regions around it can altogether generate isolated activation that can be coordinated with various joint movements and incorporated into activities of daily living (ADLs). Both the local mobility and global stability are housed within the bio-behavioral and socio-occupational factors that influence human movement (Fig. 3). Together, the mobility and stability components make up the movement control schema that are necessary to allow the lumbar spine to move in a dynamically controlled fashion.

The proposed movement control schema has several advantages:

- The schema clarifies that movement control does not equal motor control alone. Rather, movement control views motor control as one component among others necessary for improved lumbar movement (Fig. 3).
- The schema embraces both the pathokinesiology and kinesiopathology models of movement impairment. Local mobility speaks to pathokinesiology, which considers how tissue dysfunction can lead to movement impairment. Global stability speaks to kinesiopathology, which considers how movement impairment can lead to tissue dysfunction.
- The schema provides a rationale for manual therapy of impaired mobility of nerves, joints, and soft tissues as components of the movement control approach to rehabilitation. These mobility interventions can be employed concurrently with stability interventions such as motor control exercise, endurance, and strength training.
- The schema considers the structural and psychosocial variables that may degrade movement control. This consideration, in addition to specific mobility and stability needs, helps rehabilitation providers account for all factors that influence the patient’s movement potential.

The movement control schema is translated into a clinical movement control approach in the following sections.

### Movement Control Approach

To determine if the movement control rehabilitation approach is appropriate for a given patient, rehabilitation providers should view this approach through the lens of the larger 2015 TBC for managing LBP (Fig. 1). This system has been described elsewhere.5

Using the TBC, if a patient is thought to be a candidate for rehabilitation management, he/she can be triaged into one of 3 rehabilitation approaches: symptom modulation, movement control, or functional optimization. Each approach has specific clinical criteria that indicate the use of that approach (Tab. 1). It is important to realize that these criteria do not use number of days since onset to triage the patient into the movement control approach; rather, the criteria are based on the levels of pain and disability, and the clinician’s perception of the overall clinical presentation.29

The patient with movement control impairment can fit into one of the following clinical scenarios.30 The first clinical scenario is if a patient has had a new onset of LBP that started suddenly and created significant symptomatic features. Because of the significant symptoms, the patient can initially be triaged into the symptom modulation approach to reduce symptom intensity. However, after the symptoms settle down, some patients continue to describe moderate-to-low-level disability that interferes with their ADLs. Although they still have lingering pain and symptoms, it is the functional impairment(s) that dominate the clinical picture. This description meets the criteria of a movement control approach; the patient should be...
Figure 3.
Movement control schema: local mobility and global stability. Movement control requires local mobility and global stability. It is housed within the bio-behavioral and socio-occupational factors. **Local mobility** ensures that the lumbar spine and its adjacent joints independently possess adequate neural, joint, and soft tissue mobility. **Global stability** ensures that the muscles of the lumbar spine and in regions can meet activation, acquisition, and assimilation needs of lumbar spine movement. **Bio-behavioral and Socio-occupational** are yellow and blue flags.

Nerve

Exam findings:
- Positive sensitized neural tension tests (slump test, straight leg raise, femoral nerve tension, etc.)

Treatment: Neural mobilization*
* If symptoms are aggravated, reclassify patient into symptom modulation approach

Joint

Exam findings:
- Limitation, asymmetry or hypomobility of joint motion in the lumbar or adjacent regions (joint palpation for mobility, range of motion findings, etc.)

Treatment: Manual therapy for joints (manipulation and mobilization)

Soft Tissue

Exam findings:
- Impaired soft tissue compliance to manual pressure or passive change in joint position.

Treatment: Manual therapy for soft tissues (passive stretching and soft tissue mobilization)

Activation

Exam findings:
- Observation of poor ability to activate individual muscles or isolated movement patterns (transversus abdominis, multifidus, scapular retractors, breathing pattern, etc.)

Treatment: Training to activate hypoactive muscles or isolated movement patterns (abdominal hollowing, scapular retraction, breathing pattern, etc.)

Acquisition

Exam findings:
- Observation of impaired ability to dissociate or coordinate thoracolumbar and lumbopelvic/hip movements (active straight leg raise, active hip extension, active hip abduction, etc.)

Treatment: Training to acquire the skill of dissociating or coordinating movements of the lumbar spine and adjacent regions (single plane co-contraction exercises, balance and coordination exercises, etc.)

Assimilation

Exam findings:
- Observation of impaired control of multiaxial movements under dynamic loading conditions (poor squat, poor lunge performance, poor rotational movement)

Treatment: Training to assimilate loaded multiaxial movements into ADLs (step up/down progression, sit-to-stand progression, multiaxial movement progression, etc.)
Treatment-based Classification System in LBP: Movement Control Approach

<table>
<thead>
<tr>
<th>Variables</th>
<th>Treatment Modifying Variables</th>
<th>Rehabilitation Approach</th>
<th>Symptom Modulation</th>
<th>Movement Control</th>
<th>Functional Optimization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disability rating</td>
<td>Comorbidities</td>
<td>Pain rating</td>
<td>High to moderate</td>
<td>Moderate to low</td>
<td>Low to absent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disability rating</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clinical status</td>
<td>Volatile: symptoms</td>
<td>Stable: movement</td>
<td>Well-controlled:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>predominate</td>
<td>impairments predominate</td>
<td>performance</td>
</tr>
</tbody>
</table>

- When the classification variables do not agree, we recommend relying on disability rating to match the patient with the treatment approach. This judgment should be aided with the clinical status.
- Disability can be assessed with any outcome measure of disability (eg, Modified Low Back Disability Questionnaire, Roland-Morris Disability Questionnaire). "Volatile" means that the patient's clinical status can easily be aggravated, the patient's pain is highly irritable, and occasionally the patient's presentation does not permit physical examination. "Stable" means that the patient's clinical status can increase with certain movements, postures, or tests but return to baseline level relatively quickly. "Well-controlled" means that the patient's clinical status is asymptomatic most of the time but can be aggravated when performance demands are increased.
- Psychosocial status can be assessed using outcome measures (eg, Fear-Avoidance Behavior Questionnaire, StarT Back Tool, Optimal Screening for Prediction of Referral and Outcome-Yellow Flags [OSPRO – YF]). (+) means the patient needs graded cognitive behavioral therapy because of a higher risk of developing poor treatment outcome; (–) means the patient does not need graded cognitive behavioral therapy because of no concern about developing poor treatment outcome.
- Comorbidities can be present along with low back pain (eg, diabetes, arthritic condition, depression, catastrophizing). (+) means the patient needs to receive medical co-management for existing comorbidities beside rehabilitation care; (–) means the patient does not need medical co-management.

The movement control approach is reclassified from symptom modulation into the movement control approach. Alternatively, if after the symptom modulating treatment the patient has minimal pain and disability, they may be discharged.

The second clinical scenario is when the patient does not have any recent history of a significant LBP episode, but rather the symptoms started gradually. For no known reason, the patient has a low baseline level of pain that can be aggravated by doing certain ADLs; however, the pain returns to baseline levels as soon as the patient quits the activity. For this patient, the impairment of normal activities is more bothersome than the pain itself. This type of patient may not benefit from treatments geared only toward symptom modulation. Therefore, the patient should be classified into the movement control approach without having to first pass through the symptom modulation approach.

Finally, patients may describe recurrent/repeated episodes of pain that are aggravated with sudden/unexpected movements, but they experience asymptomatic intervals between episodes. These patients may shift between symptom modulation and movement control approaches according to their status at the moment of clinical presentation. If the patient is seen during the peak of their symptoms, then they should be classified into a symptom modulation approach. Once their symptoms are reduced, they should be reclassified into the movement control approach. However, if the patient is seen during the asymptomatic interval, they should be classified into the movement control approach.

It is important to note that the movement control approach in the 2015 TBC is not equivalent to the immobilization/stabilization categories described in the previous versions of the TBC. Rather, the movement control approach as proposed attempts to consider relevant factors required for optimizing movement (Fig. 2). The ultimate goal of this addition to the TBC is to provide clinicians with a more encompassing framework upon which to base their rehabilitation decisions.

In addition, the movement control approach in the 2015 TBC is based upon a distinct physical examination that differs from the examinations for symptom modulation and functional optimization approaches. The examination for movement control specifically aims to assess movement impairment.

The movement control approach is linked to the International Statistical Classification of Diseases and Related Health Problems (ICD-10) and its associated International Classification of Functioning, Disability and Health (ICF) (Tab. 2).²

Examination for the Movement Control Approach

The examination starts with a patient interview followed by a local mobility and global stability examination. A proposed examination is included in eAppendix 1 (available at https://academic.oup.com/ptj) (future studies are needed to determine the reliability of some tests).

Patient Interview. The patient interview has 3 purposes: identifying rehabilitation goals, determining aggravating and relieving factors, and uncovering barriers to recovery. Establishing realistic rehabilitation goals with the patient enables the rehabilitation provider to determine whether the patient can be discharged after regaining movement control, or if they need to be reclassified into the functional optimization approach because of a desire for higher performance. Determining the provoking and easing factors enables the rehabilitation provider to teach the patient how to avoid tissue overloading during their ADLs, and most importantly how to create a tailored safe exercise program that does not exacerbate symptoms during rehabilitation. Knowing the barriers to recovery
enables the rehabilitation provider to address them during the rehabilitation program.

The local mobility examination. The local mobility examination (Fig. 3; eAppendix 1) aims to investigate if lumbar movement is hindered by impairment in the following domains:

- Neural mobility;
- Joint(s) mobility;
- Soft tissue mobility.

The assessment of neural mobility primarily investigates whether the nerves can tolerate mechanical loading (ie, tension, glide, elongation, and angulation). This involves using neural dynamic techniques such as slump test, straight leg raise test, and femoral nerve tension test. These tests are usually done with and without position variations of the head, hip, knee, and foot. In certain instances, the assessment of the neural mobility may reveal significant nerve root tension signs that present concomitantly with severe symptoms. Such findings suggest that the patient may not be appropriate for the movement control approach at the moment and instead should be reclassified into the symptom modulation approach. Alternatively, a patient with impaired neural mobility may receive neurodynamic techniques.

The assessment of joint mobility investigates whether the lumbar spine and adjacent regions possess proper joint alignment and ability to move freely within physiologic limits. Assessment of joint mechanics involves observing spinal curvatures, alignment relationships, and assessing the mobility of the joints. When joint mechanics are impaired, certain joints become more mobile than other joints. This incongruous motion of the spinal joints may cause mechanical stress to accumulate at the more mobile joints than others, which can lead to tissue overload or injury. Impaired joint mobility can be addressed with manual therapy techniques.

The assessment of soft tissue mobility investigates whether the soft tissues of the lumbar spine and its adjacent regions can undergo elastic deformation when manual pressure or passive change of joint position are applied. When soft tissue mobility is impaired, faulty movement compensations and incoordination may result and can possibly leads to injury. Soft tissue mobility impairments can be addressed with various types of manual therapy interventions.

### Table 2

<table>
<thead>
<tr>
<th>ICD-10 Diagnosis That Corresponds to ICF Diagnosis</th>
<th>Signs and Symptoms</th>
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<tbody>
<tr>
<td>ICD-10 diagnosis: Instability</td>
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</table>

- Acute exacerbation of recurring low back pain and associated (referred) lower extremity pain.
- Symptoms produced with initial to mid-range spinal movements and provocation of the involved lumbar segment(s).
- Movement coordination impairment of the lumbopelvic region with low back flexion and extension movements.

| ICF diagnosis: Acute LBP with movement coordination impairment | 

- Subacute exacerbation of recurring low back pain and associated (referred) lower extremity pain.
- Symptoms produced with mid-range motions that worsen with end-range movements or positions and provocation of the involved lumbar segment(s).
- Lumbar segmental hypermobility may be present.
- Mobility deficits of the thorax and pelvic/hip regions may be present.
- Diminished trunk or pelvic-region muscle strength and endurance.
- Movement coordination impairments while performing self-care/home management activities.

| ICD-10 diagnosis: Instability | 

- Chronic, recurring low back pain and associated (referred) lower extremity pain.
- Presence of 1 or more of the following:
  - Low back and/or low back–related lower extremity pain that worsens with sustained end-range movements or positions.
  - Lumbar hypermobility with segmental motion assessment.
  - Mobility deficits of the thorax and lumbopelvic/hip regions.
  - Diminished trunk or pelvic-region muscle strength and endurance.
  - Movement coordination impairments while performing community/work-related recreational or occupational activities.

The global stability examination.

The global stability examination (Fig. 3; eAppendix 1) aims to investigate if lumbar movement is impaired by one of the following domains:

- Activation;
- Acquisition;
- Assimilation.

Activation assesses the ability of an individual muscle to generate isolated contraction and/or a simple movement pattern. Examples of that include abdominal hollowing, scapular retraction, multifidus activation, and breathing pattern.

Acquisition assesses whether movement is dissociated or coordinated between the lumbar spine and its adjacent regions. Acquisition is tested using basic and advanced motor control abilities (eg, active straight leg raise, active hip extension, active hip abduction). When these abilities are compromised, movement appears discordant between regions.

Assimilation of movement assesses how newly acquired skills are integrated into ADLs utilizing multiplanar movements under dynamic loading conditions. Assimilation is tested by asking the patient to describe activities that aggravate their symptoms. These activities vary with each patient; however, they generally include lifting/lowering, pushing/pulling, reaching/handling, twisting, and reciprocating. To test how a patient integrates such activities into a daily living function, the rehabilitation provider should simulate these activities in the clinic and plan the rehabilitation strategies accordingly.

Treatment for the Movement Control Approach

In this manuscript, we will not propose treatment subgroups matched to specific exercise interventions; rather, we will present an overall movement control rehabilitation approach. This is not because we believe that treatment subgroups do not exist, but because there is no consensus on what they are. We believe that the search for movement control subgroups is still a work in progress, and that our movement control approach to rehabilitation is a first step in that direction.

We realize that a number of existing classification systems have attempted to classify patients into motor control subgroups using different philosophies, and we think that this work has greatly improved our understanding of motor control. However, none of these classification systems has yet shown that any of their proposed subgroups can successfully be matched to a specific motor control intervention. This lack of subgroup-matched interventions for motor control is also conveyed in the latest APTA practice guidelines for LBP. In these guidelines, interventions of trunk coordination, strengthening, and endurance exercises are recommended for impairment of movement coordination without specific description of which exercise should be matched to which subgroup.

The current situation may be propelled into a clearer direction of matching treatments to clinical findings by providing the rehabilitation provider with a framework to design a movement rehabilitation approach unique to each patient’s clinical presentation.

This approach, after examination, plans movement control rehabilitation by first taking into account the following considerations:

- The symptomatic features; patients with severe symptoms should be classified into the symptom modulation approach.
- The unmodifiable factors; if a patient has physical (eg, wider pelvis, leg discrepancy), genetic (eg, hypermobility), or pathological (eg, stenosis or spondyloolisthesis) factors, they need to be considered during treatment planning.
- The psychosocial and comorbidity status; if present, they should be addressed during the movement rehabilitation.

Then, the rehabilitation provider should determine the local mobility and global stability impairments based on the examination findings proposed in eAppendix 1. Because patients sometimes present with impairments that require multiple interventions, these impairments in our opinion should be addressed in the following prioritization: neural mobility impairment, joint and soft tissue mobility impairment, motor control impairment, and endurance impairment. This prioritization of the interventions guides rehabilitation providers so they do not initiate maximal endurance and strength training without first ensuring that the patient has sufficient mobility and proper motor control.

Interventions for neural mobility impairment. Addressing neural mobility impairment aims to regain mobility of the nerves to enable proper conduction of neural signals to muscles. Proper neural signal is important for proper muscle activation, which is part of the motor control training process. Neural mobility is regained by asking the patient to avoid provocative positions while providing treatment via nerve gliding/flossing techniques. While employing these techniques, rehabilitation providers may use manual therapy to hasten the improvement of nerve mobility.

Interventions for joint and soft tissue mobility impairment. Addressing mobility impairment aims to regain proper joint motion and soft tissue compliance of the lumbar spine and its associated proximal and distal regions. This is important because it relieves the stress from the excessively moving lumbar spine, allows the soft tissue to exploit the whole potential of the joint’s range of motion, and prepares the musculature for proper skill acquisition during the motor control training process. Addressing joint and soft tissue mobility impairments is done primarily by skilled or self-administered manual therapy.

Interventions for motor control impairment. Addressing motor control impairments aims to regain timely muscle activation, sequenced skill acquisition, and coordinated movement assimilation. Motor control
is the essence of the movement control approach because its end goal is to correct movement and integrate the lumbar movement system into functional ADLs. Addressing motor control impairments may initially be done in spine positions away from end range. As the patient progresses in exercises, resuming normal range of motion should be encouraged.

The activation exercises aim to activate hypoactive muscles or isolated movement patterns; they are based on tests that the patient performs in a single plane of motion (e.g., abdominal hollowing). If the test was poorly performed or compensated, then the test becomes the patient’s exercise. In certain instances, the muscle may be found severely weak or inhibited such that the patient cannot initiate the motion; in that case, the rehabilitation provider should start training muscle activation with isometric exercises, progress to non-weight-bearing/gravity-assisted exercises, and eventually to gravity/mandually resisted exercises. As stated above, when prescribing muscle activation exercises it is important to consider any mobility deficits that may interfere with the joint motion. Additionally, the activation exercises may be accompanied by continuous verbal and tactile feedback in order to facilitate muscle activity.

The acquisition exercises aim to train a patient how to acquire the skill of dissociating or coordinating movements of the lumbar spine and adjacent regions. These exercises are based on tests that assess dissociation of thoracolumbar or lumbopelvic/hip movement (e.g., active straight leg raise, active hip extension). If a test reveals that the movement of the lumbar spine is not dissociated from the movement of its adjacent regions, then that test becomes the patient’s exercise. The acquisition of a skill involves learning, so the rehabilitation provider may use verbal feedback or manual cues in order to guide proper exercise performance.

Proper performance of acquisition exercises depends on sufficient mobility of the joints and soft tissues. For example, the bird-dog exercise requires sufficient mobility of the hip, thoracic, and shoulder joints, as well as sufficient compliance of the iliopsoas and latissimus dorsi muscles. If the mobility of these joints and soft tissues is suboptimal, the performance of the bird-dog exercise will also be suboptimal.

The assimilation exercises aim to assimilate the learned skills into functional activities. Assimilation rehabilitation may involve activities related to lifting/lowering, pushing/pulling, reaching/handling, trunk twisting, or reciprocating. A patient whose symptoms are aggravated with lifting/lowering may be rehabilitated with deadlifts and eccentric lowering. A patient whose symptoms are aggravated with vacuuming may require torsional stability rehabilitation such as unilateral cable row from standing or unilateral dumbbell row from a bend-over position. A patient whose symptoms are aggravated with reciprocating may be rehabilitated with walking while alternating dumbbells between hands. Determining which of these exercises to emphasize varies depending on the patient’s specific ADLs requirements.

In eAppendix 2 (available at https://academic.oup.com/ptj), the activation, acquisition, and assimilation exercises are contrasted with similar phases of motor control from other rehabilitation approaches.

Considerations related to motor control exercises. During motor control exercises, a level of muscle endurance and strength automatically develops due to the inherent muscle tension that occurs during training. This level of endurance and strength is minimal to moderate depending on the intensity of the motor control exercise (Fig. 3). However, the primary purpose of the motor control exercises is not to target endurance and strength but to correct movement impairment and enable the patients to resume their ADLs. Once this goal is achieved, the patient may be discharged. If the purpose of exercise shifts to maximizing endurance and strength for occupation or athletic performance, the patient should be reclassified into the functional optimization approach (Fig. 1).

Also, during motor control exercises, a patient does not have to be started sequentially with activation exercises followed by acquisition exercises and ending with assimilation exercises. If the patient has proper activation, he/she can start with acquisition exercises. Also, if the patient has proper acquisition, he/she may start with assimilation exercises. The patient does not need to be trained to do skills they already possess; instead, the focus should always be on correcting the movement that the patient is unable to perform properly.

Additionally, during activation and acquisition exercises, co-contraction of trunk muscles should not be emphasized in all patients equally. Some patients have muscle hyperactivity that first requires normalization. Normalization of muscle hyperactivity can be achieved with manual therapy, breathing exercises, abdominal hollowing, as well as verbal and tactile cues to relax. Once muscle hyperactivity is mitigated and normalized, the patient can be progressed to exercises that involve co-contraction.

During assimilation exercises, traditional strength training of isolated muscles may not automatically transfer to functional ADLs. For the training to transfer into ADLs successfully, the motor control exercise needs to simulate the functional task. This is known as the Transfer Principle of motor control, which states that training should be similar to the activity and the environment in which the task is performed. Training that is not similar to the required functional task has been shown to poorly transfer into ADLs and actually may create inappropriate motor patterns.

The interventions described in this movement control approach are not separate silos; rather, they represent a spectrum from the symptom modulation to functional optimization approaches. The intervention of mobility represents the bridge that links the movement control approach back to the symptom modulation approach and vice versa. The intervention of endurance training represents the bridge that links the movement control approach forward to...
the functional optimization approach and vice versa. This means that a patient classified into one approach can be reclassified into another if their signs and symptoms change. Alternatively, if the patient's status significantly improves, the patient can be discharged at any point in any of the rehabilitation approaches. This ensures fluidity within the rehabilitation process, and removes the static assignment of a patient to a particular treatment during an episode of care.

Summary

We propose a movement control schema as part of a larger rehabilitation approach. The schema postulates that to attain proper movement of the lumbar spine, the spine and its adjacent joints should possess local mobility and global stability. Local mobility means that the lumbar spine and its adjacent regions possess adequate nerve and joint mobility and soft tissue compliance. Global stability means that the muscles of the lumbar spine and its adjacent regions can generate activation that is coordinated with various joint movements and incorporated into ADLs. Both local mobility and global stability are housed within the bio-behavioral and socio-occupational factors that influence movement. The interaction between local mobility and global stability achieves the desired goal of dynamically controlled movement of the lumbar spine.

From this new schema, we propose a movement control approach to treating LBP for patients who have moderate to low levels of pain and disability, and an overall clinical presentation that seems non-volatile. This schema is translated into a physical examination procedure that tests for the integrity of the neural, joint, and soft tissue mobility, as well as the ability of muscles to achieve activation, acquisition, and assimilation requirements of spinal movement. The physical examination findings formulate the basis for treatment guidance.

From the physical examination, we suggest a treatment that aims to address neural sensitivity, joint and soft tissue mobility, and motor control. This treatment should be tailored according to the patient's movement impairments.

It is important to recognize that the movement control approach presented in this paper is largely based on clinical experience and indirect evidence. There are no randomized controlled trials to support this approach, and further clinical research is clearly needed to investigate its clinical utility.

Author Contributions and Acknowledgments


Writing: M. Alrwaily, G. Kawchuk, M. Schneider, M. Timko

Data collection: M. Alrwaily

Project management: M. Alrwaily, A. Delitto, M. Schneider

Clerical/secretarial support: M. Alrwaily

Consultation (including review of manuscript before submitting): M. Alrwaily, C. Bise, A. Delitto, G. Kawchuk, M. Schneider, J. Stevans, M. Timko


The authors thank Mr Daniel Bellon for helping with designing the figures.

Funding

There are no funders to report.

Disclosures and Presentations

The authors completed the ICJME Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest. J. Stevans is a consultant with Landmark Healthcare Inc and is a recipient of a Patient-Centered Outcomes Research Institute (PCORI) grant; A. Delitto is a recipient of PCORI and National Institutes of Health grants.

DOI: 10.1093/ptj/pzx087

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Treatment-based Classification System in LBP: Movement Control Approach


