

The use of “stabilization exercises” to affect neuromuscular control in the lumbopelvic region: a narrative review

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It is well-established that the coordination of muscular activity in the lumbopelvic region is vital to the generation of mechanical spinal stability. Several models illustrating mechanisms by which dysfunctional neuromuscular control strategies may serve as a cause and/or effect of low back pain have been described in the literature. The term “core stability” is variously used by clinicians and researchers, and this variety has led to several rehabilitative approaches suggested to affect the neuromuscular control strategies of the lumbopelvic region (e.g. “stabilization exercise”, “motor control exercise”). This narrative review will highlight: 1) the ongoing debate in the clinical and research communities regarding the terms “core stability” and “stabilization exercise”, 2) the importance of sub-grouping in identifying those patients most likely to benefit from such

Il est bien établi que la coordination de l'activité musculaire dans la région lombo-pelvienne est vitale à la génération de la stabilité mécanique de la colonne vertébrale. Les ouvrages spécialisés fournissent la description de plusieurs modèles illustrant les mécanismes par lesquels les stratégies de contrôle neuromusculaire dysfonctionnelles peuvent être une cause ou un effet de la lombalgie. Le terme « stabilité du tronc » est employé de différentes manières par les cliniciens et les chercheurs, et ces variations dans l'emploi du terme ont mené à plusieurs approches en matière de réadaptation que l'on fait valoir comme affectant les stratégies de contrôle neuromusculaire de la région lombo-pelvienne (p. ex. « exercice de stabilisation », « exercice de contrôle moteur »). Cette revue narrative soulignera : 1) le débat continu dans les communautés clinique et de la recherche sur les termes « stabilité du tronc » et « exercice de stabilisation »; 2) l'importance du regroupement en sous-groupes lorsque l'on identifie les patients les plus susceptibles de bénéficier de telles interventions thérapeutiques;

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therapeutic interventions, and 3) two protocols that can assist clinicians in this process.

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Introduction

Low back pain (LBP) is a significant public health problem and has been described as exhibiting epidemic proportions.¹ It has been estimated that 50-85% of the population will experience LBP at some point during their lives and that 10-30% of the population experiences LBP at any given moment.²⁻³ LBP imposes a significant and increasing socioeconomic burden with estimated total costs comparable to those attributed to conditions such as heart disease and diabetes,^{4,7} and results from the Global Burden of Disease Study 2010 indicate that it is now the leading contributor to global disability.⁸ Importantly, it is the 5-10% of LBP cases that become chronic which account for a majority of the total costs attributed to the condition.^{6,9,10}

Due to these high costs, investigating the most effective means of diagnosing and treating chronic LBP is a vital area of interest for health care authorities. To this end, international guidelines regarding the management of chronic LBP have been established.^{11,12} These guidelines are consistent in recommending “exercise therapy” for patients with chronic LBP, and recent reviews support the effectiveness¹³ and cost-effectiveness¹⁴ of this approach. Despite the abundance of support for the use of exercise therapy for chronic LBP patients, there is much debate in the literature with regards to optimal exercise prescription. A large variety of exercise modalities have received attention in both the clinical and research literature over the years, including aerobic exercise, directional preference based (McKenzie) exercise, strengthening and/or endurance training of the abdominal/lumbopelvic musculature, and various forms of “stabilization exercise” (see next section). The evidence to date suggests that such exercise modalities are generally more effective than usual care in the treatment of chronic LBP.¹³ However, there is currently no evidence to support the use of

3) deux protocoles qui peuvent aider les cliniciens dans ce processus.

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MOTS CLÉS : stabilité, contrôle moteur, stabilisation, exercice, chiropratique

one exercise approach over another since the relative effectiveness of different approaches has been shown to be generally comparable.¹²⁻¹³ Recently, it has been suggested that sub-groups of patients with LBP may respond differently to the various types of exercises that are used in clinical practice.¹³

Due to the multi-dimensional nature of LBP, the classification of the inherently heterogeneous LBP population into homogeneous sub-groups who are more likely to respond to a specific treatment approach based on factors in their history and physical examination has been advocated¹⁵⁻¹⁸ and viewed as a research priority in the field for over a decade.¹⁹⁻²² Attempts to establish specific causative factors or mechanisms of action associated with a particular patient's LBP would allow for more targeted treatments, which in turn will allow health care resources to be used more efficiently.^{16,18,20,21} Chiropractors are well-placed to be leaders in both the development (research) and implementation (clinical practice) of such approaches to the management of LBP. Being able to recognize those individuals who are more likely to benefit from active care strategies, and implement targeted strategies that are individualized to each unique presentation, would have obvious benefits for our patients; it would also serve to expand our profession's position in the wider health care community.

“Core stability” and “stabilization exercise”

It is well-established that the coordination of muscle activity around the lumbopelvic region is vital to the generation of mechanical spinal stability.^{23,24} Models illustrating mechanisms by which altered motor control strategies in this region serve as a potential cause and/or effect of LBP have been described by Panjabi²⁵⁻²⁷ and others.²⁸⁻³¹ Panjabi²⁵ described three inter-coordinated subsystems that collectively are responsible for adapting to the stability requirements of the spine during various postures and

movements: a passive subsystem (e.g. vertebrae, intervertebral discs, ligaments), an active subsystem (i.e. the muscles surrounding the spinal column), and a neural control subsystem. Dysfunctional neuromuscular control strategies (e.g. muscle activation levels, coordination of muscle contractions) could therefore result in “clinical instability”, which has been defined as the loss of the ability of the spine to maintain its pattern of displacement under physiologic loads resulting in no initial or additional neurological deficit, no major deformity, and no incapacitating pain.^{26,27}

In a seminal paper on the topic, Bergmark³² described and categorized two systems of muscles in the lumbopelvic region that contribute to spinal stability: 1) a “local system” of muscles that have an origin or insertion directly on the vertebrae, and 2) a “global system” of muscles that transfer the load directly to the thoracic cage and pelvic girdle. The “local system” has generally come to include deep muscles such as the multifidus, transversus abdominis, diaphragm, and pelvic floor muscles; whilst the “global system” is generally described as constituting the large superficial muscles such as the erector spinae, rectus abdominis, internal and external obliques, quadratus lumborum, gluteus maximus, and latissimus dorsi.^{28,32-35}

The term “core stability” is commonly used to refer to the ability of these “core” muscles to stabilize the lumbar spine and pelvic girdle during static postures and dynamic movements. A host of theories and “stabilization exercise” programs have been developed to train these muscles as a means of treating and/or preventing LBP. However, there is still much inconsistency and debate both in the clinical and research communities with regards to what constitutes “core stability” and a “stabilization exercise”. Additionally, several recent rehabilitative approaches emphasize the re-training of functional movement patterns as part of a “stabilization exercise” program, rather than focusing efforts on the training specific muscles.^{33,34,36,37}

Although chronic LBP patients demonstrate a variety of apparently dysfunctional neuromuscular control strategies,³⁸⁻⁴⁹ many stabilization exercise programs focus primarily on the training of the deep (local) muscles, particularly multifidus and transversus abdominis.⁵⁰ Localized atrophy of the multifidus⁵¹ and a delayed onset of transversus abdominis during movements of the upper limbs^{39,41} and lower limbs⁴⁰ have been shown in samples of LBP patients. However, the small magnitude and inconsistency

of these apparent delays has led some authors to challenge their clinical significance.^{28,52} Regardless, exercises have been proposed to selectively target multifidus and transversus abdominis.⁵⁰ Although there is some evidence that such exercises are able to change the recruitment of these muscles,⁵³⁻⁶⁰ these findings are not universal.^{52,61}

In addition to the changes to the multifidus and transversus abdominis that seem to be associated with LBP, samples of LBP patients also demonstrate altered neuromuscular control strategies in the superficial (global) muscles.^{38,43-45,49} As such, rather than attempting to selectively recruit the deep muscles, an alternative approach is to use an “abdominal brace” that involves the contraction of all abdominal and low back musculature during exercise protocols.³³ This type of contraction has been shown to increase spinal stability⁶² and paraspinal stiffness⁶³ compared to exercises that selectively target the multifidus and transversus abdominis. Several authors therefore recommend directing stabilization exercise programs toward grooving motor patterns that enhance spinal stability through repetition rather than specifically targeting one or two muscles.⁶⁴⁻⁶⁷

Due to the ongoing debate and inconsistency in the literature, assessing the evidence related to the effectiveness of stabilization exercise in the treatment of LBP is problematic. Several systematic reviews⁶⁸⁻⁷² and meta-analyses^{73,74} have been published on the effect of stabilization exercise programs that selectively target the multifidus and transversus abdominis. The findings are relatively consistent in suggesting that, for *chronic* LBP, such exercises are more effective in reducing pain and disability in the short, intermediate, and long term compared to no treatment, regular medical treatment, education, or general exercise. There is, however, some controversy regarding their relative effectiveness compared to other treatment interventions. Some reviews suggest that they are more effective in reducing pain and disability in the short and long term compared to spinal manipulation, mobilization, and conventional physical therapy programs,^{70,73} whilst others suggest that they are equally effective.^{68,69,71,72}

Many of the trials included in these reviews incorporate stabilization exercise programs that attempt to selectively target the multifidus and transversus abdominis in the initial phases, and gradually progress to complex postural and dynamic tasks that involve both the deep and superficial muscles. Ergo, some authors have questioned

whether the apparently beneficial clinical effects of the programs (i.e. reduced pain and disability) are due to the “re-training” of the deep muscles, the subsequent stages of the program that engage all trunk muscles, or a combination of both.^{29,70,73} To date, there are no published clinical trials that have directly compared a program focused on selective activation of the deep muscles with one focused on the contraction of all abdominal and low back musculature.

Another fundamental question related to the mechanism of action of stabilization exercise is whether the apparent clinical benefits are in fact related to changes in neuromuscular control strategies.^{70,73,75} Surprisingly, very few studies have measured both clinical variables and physiological variables to assess the degree to which changes in one may be associated with the other. In a recent clinical trial,⁵⁴ patients who underwent an 8-week stabilization exercise program showed greater post-intervention improvement in the recruitment of the transversus abdominis than those who performed general exercise or received spinal mobilization. There was also a significant, moderate correlation between improved recruitment of transversus abdominis and reduction in disability. In a recent case series of four patients with LBP,³⁶ each patient was given verbal or manual cues to alter motion and muscle activation strategies to reduce the pain felt during the performance of specific provocation tests/movements. The results demonstrated that patient-specific interventions were effective in reducing pain during the tests/movements that initially caused pain. There were also corresponding measurable changes in biomechanical variables calculated using kinematic, kinetic, and electromyographic data.

Sub-grouping: an important consideration

An important consideration that is receiving increasingly more attention in the literature is the heterogeneity of the patient samples in previously-conducted clinical trials investigating the effectiveness of stabilization exercise.^{67,70,72,73,75-77} There is preliminary evidence that treatment targeted at specific LBP patient sub-groups is more effective than non-targeted treatment.⁷⁸⁻⁸⁰ However, definitive conclusions regarding the size of such matched treatment effects cannot be made based on the current evidence in this area.⁷⁷

Certain sub-groups of chronic LBP patients have been

shown to possess specific dysfunctional neuromuscular control strategies that are not apparent when these sub-groups are pooled with other LBP patients.⁸¹⁻⁸⁴ It has therefore been suggested that stabilization exercise may be more effective in a select sub-group of LBP patients.^{36,54,61,73,76} A recent systematic review⁷⁶ investigated the level of participant sub-grouping in randomized controlled trials investigating the effectiveness of manual/exercise therapy for patients with *chronic* LBP. As of December 2008 (the last month included in the review’s literature search), only five trials that met the review’s search criteria reported using a clinical protocol to sub-group participants. None of these trials involved the use of a stabilization exercise intervention treatment arm. In another systematic review⁷⁷ investigating the relative effectiveness of targeted vs. non-targeted manual/exercise therapy for patients with LBP, one trial involving *acute and sub-acute* LBP patients met the review’s search criteria and involved a stabilization intervention treatment arm.⁷⁸ This trial used a classification system proposed by Delitto and colleagues⁸⁵ (discussed further in the next section) to classify study participants into three sub-groups, including one for whom stabilization exercise was recommended. Since these reviews, one small trial has been published⁸⁶ that utilized a clinical prediction rule proposed by Hicks and colleagues⁸⁷ (also discussed further in the next section) to identify patients with “lumbar segmental instability” for selective inclusion in the trial.

To improve the current state of evidence related to sub-group classifications for LBP interventions, it has been recommended that: 1) future clinical trials investigating specific interventions for LBP (including stabilization exercise) incorporate the use of reliable and valid clinical protocols to create homogeneous patient samples,^{76,88} and 2) such protocols should be based on identifying the underlying mechanism(s) of action for the specific disorders under investigation.⁷⁶ To this end, future trials investigating the effectiveness of stabilization exercise need to include both clinical and physiological variables in order to answer three fundamental questions:⁷⁵

- Are neuromuscular control deficits actually present in the trial participants who receive interventions designed to treat these deficits?
- Does the intervention achieve the intention of changing the neuromuscular control deficit?

Table 1:

Summary of two clinical protocols proposed to identify low back pain patients who are more likely to respond to stabilization exercise intervention

Classification system	Patient type	Clinical features of interest	Intervention	Definition of a positive outcome (treatment success)	Features of the system	Limitations of the current evidence base
Treatment-Based Classification ⁸⁵	Acute LBP patients	- History of frequent recurrent episodes of LBP precipitated by minimal perturbations - History of alternating sides of a lateral shift deformity (i.e. antalgic posture) - History of frequent spinal manipulation with short-term relief - History of trauma, pregnancy, or use of oral contraceptives - Pain relief with immobilization (e.g. external support, abdominal bracing) - Clinical signs of generalized ligamentous laxity - Clinical signs of "segmental instability" (e.g. presence of aberrant movement during lumbar ROM testing, positive posterior shear test)	Not specified	Not specified	Not specified	- Has only been applied in clinical trials involving samples of <i>acute</i> and <i>sub-acute</i> LBP patients - The number of criteria that must be present to categorize a patient as being more likely to respond to the intervention has not been specified - The intervention to apply to patients who are deemed more likely to respond has not been specified - The definition of a positive outcome that can be expected has not been specified
Clinical Prediction Rule ⁸⁷	Not specified	- Age < 40 years - Average SLR > 91° - Presence of aberrant movement during lumbar ROM testing - Positive prone instability test	Abdominal bracing in various positions; progression directed by a physical therapist (8 week program)	≥ 50% reduction in disability score (ODI)	If ≥ 3/4 variables are present, +LR: 4.0 (95% CI: 1.6-10.0) If 2/4 variables are present, +LR: 1.9 (95% CI: 1.2-2.9)	- Has only been applied in one small clinical trial involving a sample of <i>chronic</i> LBP patients - Has not undergone full validation or impact analysis testing

Abbreviations: CI: confidence interval; FABQ: Fear Avoidance Belief Questionnaire; LBP: low back pain; ODI: Oswestry Disability Index; ROM: range of motion; SLR: straight leg raise; +LR: positive likelihood ratio.

- Are improvements in clinical outcomes (e.g. pain and disability) related to changes in neuromuscular control deficits?

Identifying patients more likely to benefit from "stabilization exercise"

The previous section highlighted the need for future trials to incorporate the use of reliable and valid clinical protocols to identify patient sub-groups in their study design. Such protocols would also be of obvious benefit to clinicians to assist them in identifying patients who are more or less likely to benefit from stabilization exercise.

Although methods to objectively quantify spinal stability have been proposed,^{23,89} these methods involve the use of advanced technology and mathematical modeling that make them of limited use in a routine clinical setting. A handful of clinical protocols have been proposed for identifying LBP patients who are more likely to respond favourably to stabilization exercise. Although none has gained universal acceptance, a non-systematic review of the literature revealed two protocols that have been cited in several recent systematic reviews on the topic.^{77,90-93} Table 1 describes the features of these two protocols, and a summary of the evidential support for their clinical use

Table 2:

Operational definitions of the testing procedures described for use in the two clinical protocols proposed to identify low back pain patients who are more likely to respond to stabilization exercise intervention

Classification system	Clinical procedure	Operational definition
Treatment-Based Classification ⁸⁵	Clinical signs of generalized ligamentous laxity	Beighton score $\geq 4/9$: One point is assigned for the ability to perform each of the following: 1) passive extension of the left fifth finger $> 90^\circ$, 2) passive extension of the right fifth finger $> 90^\circ$, 3) passive apposition of the left thumb to the flexor aspect of the forearm, 4) passive apposition of the right thumb to the flexor aspect of the forearm, 5) hyperextension of the left elbow $> 10^\circ$, 6) hyperextension of the right elbow $> 10^\circ$, 7) hyperextension of the left knee $> 10^\circ$, 8) hyperextension of the right knee $> 10^\circ$, 9) forward flexion of the trunk with the knees extended and the palms of the hands resting flat on the floor.
	Presence of aberrant movement during lumbar ROM testing	Aberrant movement: instability catch, painful arc of motion, Gower’s sign, reversal of lumbopelvic rhythm
	Positive posterior sheer test	The patient is standing with arms across the lower abdomen. The examiner stands at one side of the patient and places one arm around the patient’s abdomen, over the patient’s crossed hands. The heel of the opposite hand is placed on the patient’s pelvis for stabilization. The examiner produces a posterior force through the patient’s abdomen and an anteriorly directed stabilizing force with the opposite hand. The test is repeated at all lumbar levels. A positive test is determined by the provocation of symptoms.
Clinical Prediction Rule ⁸⁷	SLR	The patient is supine. The inclinometer is positioned on the tibial crest just below the tibial tubercle. The leg is raised passively by the examiner, whose other hand maintains the knee in extension. The leg is raised slowly to the maximum tolerated straight leg raise (not the onset of pain).
	Presence of aberrant movement during lumbar ROM testing	Aberrant movement: instability catch, painful arc of motion, Gower’s sign, reversal of lumbopelvic rhythm
	Prone instability test	The patient lies prone with the body on the examining table and legs over the edge and feet resting on the floor. While the patient rests in this position, the examiner applies posterior to anterior pressure to the lumbar spine. Any provocation of pain is reported. Then the patient lifts the legs off the floor (the patient may hold table to maintain position) and posterior compression is applied again to the lumbar spine. If pain is present in the resting position but subsides in the second position, the test is positive.

Abbreviations: ROM: range of motion; SLR: straight leg raise.

is provided below; please note that a formal critical appraisal process was not used to judge the quality or risk of bias of the original research papers that have been published related to the protocols. Table 2 summarizes the operational definitions of the clinical testing procedures described for the two protocols.

Treatment-based classification system

Nearly 20 years ago, Delitto and colleagues⁸⁵ described a “treatment-based classification approach” for *acute* LBP patients involving three levels of patient classification based on specific historic features and examination findings. The authors state that the development of this classification system was based on input from clinicians of various health care disciplines rather than from a formal

derivation study. They also acknowledge that: “Although some of the tests and procedures discussed in this article have been subjected to peer-reviewed investigation, we would remind the reader that much of the decision-making rules that we propose have not been tested through prospective research.”^{85,p.471}

The classification system describes criteria that can be used to identify a sub-group of patients for whom stabilization exercise is recommended (the third level of classification). Importantly, in order to be placed into such a sub-group, a patient must first meet the following criteria: 1) he/she is deemed to have LBP that “can be managed independently and primarily by physical therapy” (the first level of classification), and 2) he/she is unable to stand for 15 minutes or more, sit for 30 minutes or more, or

walk for more than 0.4 km without worsening of pain (the second level of classification). In such cases, the following criteria are suggested to identify patients for a “stabilization exercise” sub-group:

- History of frequent recurrent episodes of LBP precipitated by minimal perturbations
- History of alternating sides of a lateral shift deformity (i.e. antalgic posture)
- History of frequent spinal manipulation with short-term relief
- History of trauma, pregnancy, or use of oral contraceptives
- Pain relief with immobilization (e.g. external support, abdominal bracing)
- Clinical signs of generalized ligamentous laxity
- Clinical signs of “segmental instability” (e.g. presence of aberrant movement during lumbar range of motion testing, positive posterior shear test)

The authors did not state a specific number of criteria that must be present to determine inclusion in this sub-group, nor a specific type of stabilization exercise program to prescribe for such patients.

The inter-rater reliability of classification assignment by physical therapists experienced with using the system has been found to be moderate⁹⁴ in two studies.^{95,96} In addition, the results of another study provides preliminary evidence regarding the construct validity of the classification system.⁹⁷ A handful of clinical trials have evaluated the effectiveness of providing treatment based on this classification system. In one trial,⁹⁸ *acute* LBP patients were randomized to receive classification-based treatment or guideline-based treatment. The type of exercise performed by the patients in the stabilization exercise sub-group was not specified. The results indicated that improvement in clinical outcomes (e.g. disability, quality of life) was significantly greater after 4 weeks in the patients who received classification-based treatment. In another trial,⁷⁸ *acute and sub-acute* LBP patients were randomized to receive spinal manipulation, stabilization exercises (involving abdominal bracing and strengthening of the abdominal and lumbar musculature), or directional preference exercises. Clinical data collected at baseline were used to determine a classification for each patient, and

comparisons were made between patients who received treatment matched to their sub-group classification and those who did not receive matched treatment. The results demonstrated that patients who received matched treatment had significantly less disability post-intervention (4 weeks) and at a 1-year follow-up. Unfortunately, the specific treatment effects for the stabilization sub-groups in both of these trials were not reported. As well, the magnitude of the overall matched treatment effect reported by Brennan and colleagues⁷⁸ has been called into question by the authors of a recent systematic review.⁷⁷ These authors stress the importance of distinguishing between *prognostic factors* (i.e. signs and symptoms that indicate a likely outcome regardless of treatment) and *treatment modifiers* (i.e. signs and symptoms that indicate a likely response to a specific treatment) when analyzing classification systems or clinical prediction rules. Using such methods, the results of this review demonstrated that although the classification system was able to identify individuals who were more likely to respond to a matched treatment, the actual treatment modifier effect size was not statistically significant.

Clinical prediction rule

More recently, Hicks and colleagues⁸⁷ published the results of a clinical prediction rule derivation study that explored the predictive value of various demographic, historic, and clinical examination variables for predicting outcome following a stabilization exercise program consisting of abdominal bracing in various positions. Four variables were found to be significantly related to treatment success (defined as $\geq 50\%$ reduction in disability score): age < 40 years, average straight leg raise $> 91^\circ$, the presence of aberrant movement during lumbar range of motion testing, and a positive prone instability test. The best rule for predicting treatment success was the presence of $\geq 3/4$ of the significant variables (positive LR: 4.0; 95% CI: 1.6-10.0).

Teyhan and colleagues⁹⁹ used this clinical prediction rule to selectively recruit a sub-group of LBP patients who demonstrated $\geq 2/4$ of the significant variables predicting treatment success. When this sub-group was compared to a sample of healthy controls, the authors were able to create a multivariate model of kinematic variables (as measured by digital fluoroscopic video) that was able to distinguish group membership. It would be useful to

repeat this study comparing a sub-group of LBP patients predicted to succeed with stabilization exercise with a sub-group predicted to fail with such treatment. In addition to this study, the results of a recent clinical trial demonstrated that an 8-week stabilization exercise program (involving abdominal bracing and abdominal hollowing exercises) plus routine exercise was more effective than routine exercise alone in reducing pain and disability in a similar sub-group of *chronic* LBP patients, both post-intervention and at a 3 month follow-up.⁸⁶

Importantly, although this clinical prediction rule has been supported to some extent by a construct validation study⁹⁹ and applied in one small clinical trial,⁸⁶ it has not undergone full validation or impact analysis testing.¹⁰⁰ Ergo, definite conclusions regarding the clinical utility of this rule cannot be made, and caution must be used when applying it in clinical practice.⁹⁰⁻⁹³

Limitations

It must be stressed that this is a narrative review, rather than an exhaustive systematic review of the topic. Narrative reviews are inherently subjective with several limitations (e.g. selection bias of the studies included). The classification system and clinical prediction rule described herein have received a moderate amount of attention by the research and clinical communities. However, there may be additional methods related to the identification of LBP patients who are more likely to respond to stabilization exercise that have been described variously in the literature, which have not been included in this review.

Future areas of research

There are several interesting avenues of research based on the current gaps in the literature related to the identification of LBP patients more likely to benefit from stabilization exercise. First, further work should explore the potential usefulness of factors or procedures other than those included as potential predictors in the previous clinical prediction rule derivation study.⁸⁷ For example, the active straight leg raise test score has been shown to be a significant predictor for recovery in females with pregnancy-related pelvic girdle pain.¹⁰¹ It would therefore be useful to include this test as a potential predictor in future derivation studies, along with other clinical procedures used to assess the neuromuscular control strategies of LBP patients. Second, once clinical protocols (e.g. clinical pre-

diction rules) have been derived, they need to undergo appropriate and adequate validation testing in clinical trials. Importantly, the patient population to which the rule is intended to be applied needs to be represented in the participant samples in such trials.

Summary

This narrative review has attempted to highlight the variety and debate in the literature regarding the terms “core stability” and “stabilization exercise”. Several recommendations for future research in this area have also been presented.

A handful of methods have been described over the years that purport to identify sub-groups of LBP patients who would likely benefit from stabilization exercise. Each has some degree of evidential support; however, all require further study before they can be used with confidence in practice. One of the main limiters regarding the use of the Treatment-Based Classification System proposed by Delitto and colleagues⁸⁵ in practice is that the evidence supporting its use is based on studies conducted with *acute* LBP patients. This is somewhat disconcerting since current guidelines generally do not recommend exercise therapy for *acute* LBP patients.^{11,12} The clinical prediction rule proposed by Hicks and colleagues⁸⁷ has some degree of evidential support, but still requires full validation and impact analysis testing.

Evidence-based health care requires clinicians to use the best *available* evidence to assist in their clinical decision making. It is suggested that the two clinical protocols described here *may* be used in clinical practice; however, clinicians need to be aware of the limitations of each based on the current evidence available, and accordingly be judicious and cautious in their application.

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