Validation of a Clinical Test of Thoracolumbar Dissociation in Chronic Low Back Pain

Motor control deficits are common in chronic/recurrent low back pain (LBP) and include altered paraspinal muscle function. Recovery from LBP does not ensure restoration of spine function or movement, and recurrent LBP involves persistent alterations of motor control, including modified coordination between short/deep (eg, multifidus) and long/superficial (eg, thoracic erector spinae) paraspinal muscles, with a tendency to contract these muscles en masse rather than to activate them differentially. Changed coordination between paraspinal muscles appears to be consistent with clinical observations of reduced ability to move the lumbar spine independently of the thorax (ie, poor “dissociation” of lumbar and thoracolumbar motion) in some individuals. Although poorly dissociated spinal movement may be relevant to LBP, clinical methods to assess this function require validation.

Identification of subgroups within the heterogeneous LBP population is a priority. Many classification schemes consider movement strategies and their relationship to symptoms. Poor ability to dissociate the lumbar and thoracolumbar regions is considered typical of some subgroups, for example, the “flexion pattern” subgroup. Treatment guided by movement patterns can improve clinical outcomes. Although some studies assert that modification of movement patterns is unnecessary to improve symptoms, these studies either did not investigate treatments that modify movement patterns or used measures that did not consider specific movement patterns. Measures of movement features are needed to identify LBP subgroups and to track recovery.

STUDY DESIGN: Clinical test validation.

OBJECTIVES: Preliminary study of concurrent and discriminant validity of a clinical test of thoracolumbar dissociation.

BACKGROUND: Control deficits of back muscles and trunk movement are common in chronic/recurrent low back pain (LBP). A reliable clinical test to rate an individual’s ability to dissociate lumbopelvic movement from the thoracolumbar region has been described. This test rates the performance quality of 5 key aspects against criterion standards.

METHODS: Concurrent validity was examined by comparison of clinical test scores (overall score and each individual criterion) against spine kinematics. Discriminant validity was evaluated by comparison of scores between pain-free controls and participants with LBP. A receiver operating characteristic curve was calculated to determine the optimal cutoff or score to differentiate between pain-free controls than for participants with LBP after 2 minutes of training (P = .045). Scores of less than 5.5 were more prevalent in the LBP group (pretraining LBP versus control, 72% versus 35%; P = .008; posttraining LBP versus control, 48% versus 16%; P = .018).


KEY WORDS: lumbar movements, movement control, spinal motion

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A clinical test has been developed to rate the ability to posteriorly and anteriorly tilt the pelvis while limiting movement of the thorax/thoraco-lumbar junction. This "clinical test of thoraco-lumbar dissociation" is described in detail elsewhere. Briefly, the test involves the following 5 criteria, scored out of 10, that consider elements of the movement: (1) quality of pelvic motion, (2) control of adjacent regions (including thorax/thoraco-lumbar junction), (3) difference between forward and backward pelvic motion, (4) ability to maintain breathing, and (5) ability to repetitively perform the task with high quality. The test's intertester reliability is good (pretraining, $\kappa = 0.81$; posttraining, $\kappa = 0.66$) when performed by experienced assessors, even using video recording. The next step involves establishing the test's validity.

This study aimed to investigate 2 aspects of the validity of the clinical test of thoraco-lumbar dissociation. First, we investigated concurrent validity between the test's individual criterion score and total score, and features of lumbopelvic/thoraco-lumbar kinematics. Second, we investigated discriminant validity by assessing the distribution of scores for groups with and without LBP. Although within-group variation of individual test performances was expected, it was considered that poor performance would be more common in the LBP group. Identification of a value that could discriminate between these groups would provide a starting point for validation of a cutoff to interpret test performance. Data from both groups were used to evaluate the receiver operating characteristic (ROC) to identify the optimal cutoff score to discriminate between groups.

**Participants**

Study 1 involved 20 pain-free individuals (mean ± SD age, 28 ± 5 years; 9 male, 11 female) and 10 individuals with LBP (age, 26 ± 6 years; 3 male, 7 female). Study 2 involved 31 pain-free individuals (mean ± SD age, 28 ± 4 years; 15 male, 16 female) and 25 individuals with LBP (age, 32 ± 10 years; 9 male, 16 female). Inclusion criteria for both groups were being 18 to 55 years of age and having a body mass index within the normal range (18.50-24.99 kg/m²). Exclusion criteria were having a suspected or confirmed spinal pathology (eg, tumor, infection, fracture, inflammatory disease), being pregnant, having nerve root compromise, or having a previous spine surgery or scheduled spine surgery. Participants in the LBP group were required to have nonspecific LBP of more than 3 months in duration, and those in the pain-free control group were to have no history of musculoskeletal pain in the past 3 months. Participants were recruited from the University of Queensland (excluding the staff and students of the School of Health and Rehabilitation Sciences). The Medical Research Ethics Committee approved the study, and participants provided written informed consent. We elected to recruit 56 participants, based on similar studies of clinical test validity and recommendations for validation studies.

**Methods**

**Study Design**

**The Concurrent Validity and Discriminant Validity of the Clinical Test Were Studied in Separate Investigations.** Study 1 investigated concurrent validity by evaluating the relationship between the total clinical score and lumbopelvic and thorax/thoraco-lumbar kinematics assessed with sensors affixed to the spine and pelvis, and the relationship between each criterion score and the features of lumbopelvic and thorax/thoraco-lumbar kinematics that the criterion was hypothesized to reflect. Study 2 evaluated the discriminant validity by comparing the test score between groups with and without LBP. Although within-group variation of individual test performances was expected, it was considered that poor performance would be more common in the LBP group. Identification of a value that could discriminate between these groups would provide a starting point for validation of a cutoff to interpret test performance. Data from both groups were used to evaluate the receiver operating characteristic (ROC) to identify the optimal cutoff score to discriminate between groups.

**Procedure**

For both studies, participants sat on a chair (110% of the height of the fibular head) with the hands relaxed on the thighs and the eyes directed toward a screen at eye level. The participants had their back exposed and wore shorts that allowed unrestricted hip motion. The assessment involved 3 stages. The first stage was the pretraining assessment, in which participants watched a standardized training video of the task, followed by 10 repetitions of movement between posterior and anterior pelvic tilt. Movement quality was assessed using the clinical test. The second stage consisted of training, in which a brief 2-minute session of standardized training was performed to address specific features of each participant’s performance (eg, feedback to limit thoraco-lumbar motion). The third stage was posttraining, in which 10 repetitions of the test maneuver were assessed using the clinical test. Pretraining and posttraining assessments were compared to examine training effects and between-group differences. Training was considered necessary to optimize task performance and to evaluate whether this impacted the between-group differences (significant interaction between group and training). A single investigator with more than 1 year of clinical experience and trained in the clinical test performed both the training/instruction and assessments.
Kinematic Measures and Analysis

In study 1, spine and pelvis kinematics were recorded during the clinical test by 4 inertial measurement sensors that incorporated three-dimensional accelerometers, gyroscopes, and magnetometers (ValedoMotion; Hocoma AG, Volketswil, Switzerland). Activation of a switch in the sensors marked each trial’s initiation. Sensors were attached with double-sided tape to the skin over the spinous processes of T5, T10, T12, and S1 (FIGURE 1). Data were collected at 200 samples per second using Valedo software and exported to MATLAB Version 7.13 (The MathWorks, Inc, Natick, MA).

Sensor orientation was derived using the Madgwick-Kalman algorithm29 and expressed in quaternions. Angular data were low-pass filtered at 5 Hz with a second-order, bidirectional Butterworth filter. The start of each measurement (before participants moved the pelvis) was used to reference the orientation of the sensors against the orientation of the S1 sensor. Motions of the thorax, thoracolumbar junction, and lumbar spine/pelvis were represented by the angular range of motion (ROM) in the sagittal plane. Movement trajectories of each sensor were displayed, and the cycles were selected to calculate ROM (amplitude of motion between minimum and maximum [total and separate for forward and backward directions]), ROM standard deviation (calculated over 10 repetitions [intertrial variation]), and jerk (rate of change of acceleration to quantify smoothness of motion [total and each direction]).

Statistical Analysis

Analysis of concurrent validity (study 1) involved analysis of the relationship between the total score or each criterion score and kinematic variables expected to reflect the criterion score (TABLE 1). Criterion 1 evaluates the quality of lumbopelvic motion by 3 kinematic variables expected to reflect the criterion score (TABLE 1). Criterion 2 relates to control of adjacent regions, the score was compared with T5 ROM and the T5/S1 ratio, with higher scores relating to lower values. Criterion 3 considers the difference in quality of performance between forward and backward motion (ie, directional preference). This score was compared with the relative amplitude of forward and backward motion (S1 ROM in the direction of least motion as a proportion of the mean S1 ROM), the jerk in each direction, the relative jerk between directions (ratio of the direction with least jerk divided by the direction with greatest jerk), and the T5/S1 ratio. Criterion 4 considers the ability to main-
tain breathing and was not assessed with the sensors. Criterion 5 assesses the ability to repeat the task with “high quality” and was considered by comparison of the score with the number of completed repetitions (identified from the movement of S1) and jerk/ROM standard deviation of S1 as measures of motion quality.

Study 2 evaluated the discriminant validity. First, normal distribution of the data was tested using the Shapiro-Francia W test. As pretraining test scores from control participants were not normally distributed, all data were transformed with a quadratic function. Clinical test scores were compared between groups (LBP versus pain free) and between training measures (pretraining versus posttraining, repeated measure) with a repeated-measures ANOVA and post hoc testing using the Bonferroni test. Performance variation within groups was plotted using 95% confidence intervals. The ROC analysis identified the score that achieved the greatest sensitivity and specificity (optimal cutoff score) to discriminate between participant groups. The difference in the proportion of good/poor performance by group was assessed with the Fisher exact test. The validity of the change in test scores with training was assessed by investigating the correlation between changes in the T5/S1 ratio (the kinematic feature most consistently related to the clinical test score), expressed as proportion change from pretraining, and the total score and each criterion score.

RESULTS

Study 1: Concurrent Validity of the Clinical Test of Thoracolumbar Dissociation

Clinical scores and kinematic variables are presented in Table 2. When movement performance was considered for the whole group, the pelvic ROM (S1 ROM) exceeded that in the thoracic/thoracolumbar region (T5 ROM, P < .001; T10 ROM, P < .001; and T12 ROM, P < .002) (Figure 2A), which indicated that, on average, the group successfully completed the maneuver. When participants were subgrouped based on the total score (cutoff score of 5.5/10 for “good” and “poor” performance from study 2), participants with poor performance (inability to move the regions separately) moved with similar ROM at S1 and T10-T12 (S1 ROM versus T5 ROM, P = .343; S1 ROM versus T10 ROM, P = .442; and S1 ROM versus T12 ROM, P = .487), whereas those with good perfor-

![TABLE 2](https://example.com/table2.png)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD (Range)</th>
</tr>
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<tbody>
<tr>
<td>Total score (0-10)</td>
<td>6.1 ± 2 (1.0-8.5)</td>
</tr>
<tr>
<td>Criterion 1 (0-3)</td>
<td>1.8 ± 0.7 (0.0-3.0)</td>
</tr>
<tr>
<td>Criterion 2 (0-3)</td>
<td>2.0 ± 0.9 (0.0-3.0)</td>
</tr>
<tr>
<td>Criterion 3 (0-2)</td>
<td>0.9 ± 0.5 (0.0-2.0)</td>
</tr>
<tr>
<td>Criterion 4 (0-4)</td>
<td>1.0 ± 0 (1.0-10)</td>
</tr>
<tr>
<td>Criterion 5 (0-1)</td>
<td>0.4 ± 0.2 (0.0-0.5)</td>
</tr>
<tr>
<td>T5 ROM, deg</td>
<td>5.4 ± 2.6 (1.7-10.5)</td>
</tr>
<tr>
<td>T10 ROM, deg</td>
<td>8.0 ± 2.8 (2.5-14.6)</td>
</tr>
<tr>
<td>T12 ROM, deg</td>
<td>8.5 ± 3.2 (2.2-15.7)</td>
</tr>
<tr>
<td>S1 ROM, deg</td>
<td>10.7 ± 4.5 (3.2-21.2)</td>
</tr>
<tr>
<td>T5/S1 ratio*</td>
<td>0.6 ± 0.3 (0.1-1.3)</td>
</tr>
<tr>
<td>S1 SD ROM†</td>
<td>17 ± 0.7 (6.8-31)</td>
</tr>
<tr>
<td>S1 jerk, deg/s²</td>
<td>589 ± 148 (38.2-90.8)</td>
</tr>
<tr>
<td>Repetition, n</td>
<td>8.8 ± 11 (4.0-110)</td>
</tr>
</tbody>
</table>

*Ratio of T5 ROM divided by S1 ROM.
†Standard deviation of S1 ROM.
performance used greater motion at S1 (S1 ROM versus T5 ROM, \(P < .001\); S1 ROM versus T10 ROM, \(P < .001\); and S1 ROM versus T12 ROM, \(P < .003\)) (FIGURE 2B). There was a modest correlation between the T5/S1 ratio and total clinical score (\(r = -0.45, P < .05\)) (FIGURE 3A). There was no significant correlation between the motion of T10 or T12 relative to pelvic motion (T10/S1: \(r = 0.34, P = .06\); T12/S1: \(r = -0.14, P = .46\)). These analyses imply that scores allocated by the clinician appear to better reflect the relative ROM of T5 and S1 than that of the segments at the thoracolumbar junction (T10 and T12). When the regression was calculated separately for each group, there was little difference in slope (LBP versus control, \(-0.10\) versus \(-0.06\)) or intercept (LBP versus control, \(1.08\) versus \(0.91\)), which implies that the clinician was not biased to give lower scores to LBP participants.

Analysis of the relationship between scores for individual criteria and the kinematic measures they reflect provided variable results, with insight into the features that the clinicians used to form their judgments (TABLE 2). Criterion 1 (quality of pelvic motion) was not significantly correlated with S1 ROM (\(r = 0.08, P = .65\)) or S1 jerk (\(r = 0.15, P = .44\)), but was significantly correlated with T5/S1 ratio (\(r = -0.37, P = .043\)) (FIGURE 3B). Criterion 2 (control of adjacent regions) was not significantly correlated with T5 ROM (\(r = -0.27, P = .135\)), but was significantly correlated with the T5/S1 ratio (\(r = -0.47, P < .008\)) (FIGURE 3C). Taken together, these data imply that scores for criteria 1 and 2 were related to relative motion of the pelvis and thorax rather than to the absolute motion of these segments.

Criterion 3 (difference in quality between forward and backward motion) was not correlated with the relative motion in each direction (S1 ROM in the direction of least motion as a proportion of mean S1 ROM: \(r = 0.14, P = .47\)), measures of quality (jerk in anterior [\(r = -0.04, P = .85\]) or posterior [\(r = -0.09, P = .62\)] directions), or the ratio between direction of least and most jerk (\(r = 0.06, P = .77\)). Criterion 3 was moderately correlated with the T5/S1 ratio (\(r = -0.43, P < .02\)) (FIGURE 3D). These data imply that the relative motion of the thorax and pelvis influenced the rater’s decision rather than the relative ROM or movement smoothness between directions.

Although criterion 5 (ability to perform the task repetitively) was not correlated with the number of repetitions (\(r = 0.23, P = .20\)), S1 jerk (\(r = 0.29, P = .11\)), or S1 ROM standard deviation (\(r = -0.10, P = .62\)), it was moderately correlated with T5 ROM (\(r = -0.44, P < .014\)) and the T5/S1 ratio (\(r = -0.61, P < .001\)) (FIGURE 3E). Thus, the rater either based judgment on control of the thorax (absence of thoracic motion) relative to the pelvis or on the quality of dissociation of the spine regions.

**Study 2: Discriminant Validity of the Clinical Test of Thoracolumbar Dissociation**

Comparison of the clinical score between groups showed that pain-free participants obtained a higher score posttraining than participants with LBP (group-by-training interaction, \(P < .045\); post hoc, \(P < .006\)), but not pretraining (post hoc, \(P = .62\)) (TABLE 3, FIGURE 4). Both groups improved with training (control, \(P < .042\); LBP, \(P < .001\)) (TABLE 3). FIGURE 5 shows the distribution of clinical test scores for both groups. Although there was large variation between participants for both groups, the ROC analysis identified a threshold that provided the great-

**FIGURE 3.** Spearman correlation between ratio of ROM at T5 divided by ROM at S1 (T5/S1 ratio) and (A) total score, (B) criterion 1, (C) criterion 2, (D) criterion 3, and (E) criterion 5. Data are shown for each comparison, with the linear regression line fitted to the data. The inset at top right shows motion used to calculate the ratio.

**TABLE 3.** Discriminant Validity of the Clinical Test of Thoracolumbar Dissociation
est sensitivity (24%) and specificity (77%) to discriminate between the participants with and without LBP at a clinical test score of 5.5 (area under the ROC curve, 0.65; confidence interval: 0.503, 0.798) (FIGURE 6). If this cutoff is considered as the boundary between good (greater than 5.5) and poor (5.5 or less) performance, a higher proportion of participants with LBP (72%) than controls (35%) had poor performance pretraining ($P = .008$). After training, the proportion with poor performance remained significantly higher in the LBP group (48%) than in the control group (16%, $P = .018$) (FIGURE 5, TABLE 4).

Validity of the improvement in clinical test score with training is supported by the strong positive correlation between the increase in the T5/S1 ratio and improvement in the total clinical test score ($r = -0.60, P < .001$) and criteria 1 ($r = 0.43, P < .022$), 2 ($r = 0.46, P < .012$), and 3 ($r = 0.55, P < .002$). Criterion 4 did not change with training, and there was no significant relationship with criterion 5 ($r = 0.29, P = .13$).

**DISCUSSION**

This study assessed the concurrent and discriminant validity of a clinical test of thoracolumbar dissociation as a measure of movement strategy. We showed a significant relationship between the total test score and the thoracolumbar kinematic features that the clinical test was designed to measure. This finding supports the test’s concurrent validity. Some, but not all, of the individual criterion scores were related to the kinematic parameters they intended to measure. Four correlations were significant out of the 14 measures. This analysis provides information regarding the features of the movement task that influenced the clinicians’ scores. The results suggest that a cutoff score of 5.5 may begin to define good versus poor performance, as it discriminated between participants with and without LBP. However, further research of discriminant validity of the test must involve a larger sample, more than 1 assessor, and blinding to the LBP condition. As expected, not all participants with LBP performed the task poorly, and not all pain-free participants performed the task well. The former observation concurs with the heterogeneity of LBP and the clinical philosophy of subgrouping. However, this study was a preliminary step that investigated the discrimination between people with and without LBP, and further research is necessary to investigate the test for subgrouping. The observation of poor performance by some controls suggests that the role of movement strategy in long-term spinal health should be considered or that these false-positive findings may be due to the poor accuracy of the test in discriminating on the basis of LBP status. The difference between groups and the heterogeneity within groups concur with variation in motor control features, such as feedforward muscle activation during postural tasks,6,12,21,24 reposition accuracy,6 alterations of trunk muscle recruitment,33,34 and sex-related differences,27 among others. These data substantiate further investigation of this test to assess spinal control in LBP.

**Relationship Between the Clinical Test and Kinematic Measures**

The clinical test focuses on an individual’s ability to dissociate movement of the lumbar region from that of the thorax/thoracolumbar junction. The study of concurrent validity suggests that assessor ratings were influenced by the movement of the upper thoracic spine (T5), as evidenced by the significant correlation between the clinical test scores and the T5/S1 ratio (greater motion of T5 relative to S1 was related to higher clinical score, and the T5/S1 ratio explained 20% of the total score variance). The absence of similar relationships of the clinical score

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**TABLE 3**

<table>
<thead>
<tr>
<th>Performance/Time Point</th>
<th>Low Back Pain</th>
<th>Pain-Free Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Score*</td>
</tr>
<tr>
<td>Total group</td>
<td>25</td>
<td>4.8 ± 0.4</td>
</tr>
<tr>
<td>Pretraining</td>
<td>25</td>
<td>5.8 ± 0.5</td>
</tr>
<tr>
<td>Good performance</td>
<td>7</td>
<td>6.9 ± 0.8</td>
</tr>
<tr>
<td>Posttraining</td>
<td>13</td>
<td>7.7 ± 1.1</td>
</tr>
<tr>
<td>Poor performance</td>
<td>18</td>
<td>4 ± 1.6</td>
</tr>
<tr>
<td>Pretraining</td>
<td>12</td>
<td>3.7 ± 1.6</td>
</tr>
</tbody>
</table>

*Values are mean ± SD.*
with T10/S1 and T12/S1 ratios implies that the clinician's score considered mid-thorax motion rather than the motion of the thoracolumbar junction. The relative movement between the pelvis and thorax was related to the clinical judgments for criteria 1, 2, 3, and 5. However, kinematic indicators of movement smoothness (jerk) were not related to clinical judgments about movement quality.

The score's concurrent validity is strengthened by the observation that pelvic motion was greater than thorax/thoracolumbar motion. This suggests a pattern consistent with the correct performance of the thoracolumbar dissociation test for participants who scored above the cutoff value that was found to discriminate between participant groups (greater than 5.5). Furthermore, S1 motion was of similar magnitude to the lower thoracic region (suggesting little “dissociation” between the movements in these regions) for those who scored less than 5.5.

One issue to consider is that this study involved assessments by a single experienced assessor who was not blinded to LBP status. Intertester reliability has been reported previously. Although bias cannot be discounted, the similarities of the properties of the regression lines fit between the kinematics and test score for each group separately indicate that the rater was not systematically biased by pain status. Validity of the clinical test scores is further supported by the relationship between the clinical test score improvement and the change in the T5/S1 ratio with training.

Correlations between each criterion and kinematic data provide further insight into the features considered by the clinician to allocate scores, and some potential limitations. Criteria 1 and 2, which report movement of the pelvis and thorax/thoracolumbar junction, respectively, were correlated with the T5/S1 ratio, but not with the S1 ROM/S1 jerk or T5 ROM, respectively. This suggests that clinicians consider relative motion rather than motion or motion quality of spine regions when allocating scores. As both criteria relate to the same feature, one should consider whether additional information is gained by inclusion of both in the total score. Criteria 3 and 5, which relate to differences in quality between directions of movement and repetition, did not correlate with the kinematic features predicted to reflect these elements (eg, relative quality of movement between movement directions) but did correlate with T5 ROM (criterion 5) and/or T5/S1 ratio (criteria 3 and 5). Several issues require consideration. First, there was limited variation in these criterion scores (criterion 3, 24/31 participants scored 1; criterion 5, 24/31 scored 0.5), which may compromise the ability to observe a relationship. Second, the kinematic measures used to evaluate these criteria may not optimally reflect the features considered by clinicians. Third, the correlation between these criteria and thorax/relative thorax motion suggests either that the clinician was biased by this measure when allocating the scores or that criteria 3 and 5 are independent of motion/relative thorax motion, though participants who scored well on these criteria performed the task well overall.

Relevance for Identification of LBP Subgroups

In order to determine the most appropriate rehabilitation/treatment program, previous studies have classified patients into subgroups based on motor control characteristics. Consideration of poor ability to dissociate movements between spine regions is common in these classification methods and other assessments for LBP. Poor movement dissociation is
likely to relate to altered coordination between muscles, specifically an inability to activate deep/short lumbar muscles (that extend the lumbar spine) separately from more superficial/multisegmental muscles (that extend larger spine segments, including lumbar and thoracolumbar regions). Loss of differential control of these muscles has been identified. Previous assessments of dissociation of lumbopelvic from thoracic motion have involved dichotomous outcomes as a part of a test battery. The present study is the first to assess the validity of a clinician’s ability to evaluate thoracolumbar dissociation in participants with and without LBP and to use nondichotomous outcomes to allow greater scope to identify differences between, and changes within, individuals.

The ROC analysis identified a cutoff value of 5.5, based on the expectation that the proportion of participants with poor performance would be greater in the LBP group. This was considered preliminary, as we did not expect the performance by participants with LBP and pain-free participants to be uniformly poor or good. Although the area under the curve (AUC) showed low values for sensitivity and specificity of the cutoff (AUC between 0.60 and 0.70, which is interpreted as poor), the validity of this value was supported by the observation that S1 ROM was not greater than that of T10 and T12 (indicating inability to dissociate pelvic from thoracic motion) for the participants who scored below the cutoff. Further research is needed to evaluate the potential utility of the test to discriminate subgroups within LBP.

Intersubject Variation in the Ability to Dissociate Thoracolumbar Motion

The results show variation in performance of the clinical test between individuals in both groups. Distribution of data in the control group showed some polarization of the scores at the good and poor ends of the spectrum. Such variability could be relevant to LBP development. Although this study cannot determine whether poor dissociation of lumbar from thoracolumbar motion is a cause or a consequence of LBP, this feature of motor control may be a risk factor for LBP if an individual is adequately “exposed.” This requires further investigation. One additional consideration is that our groups involved men and women, but the number of participants was not sufficient to examine possible sex effects. The exclusion of overweight/obese participants also needs further investigation.

Clinical Implications

This study provides a foundation for a clinical test to aid assessment of the ability to dissociate movement of spinal regions in LBP. Further work is required to demonstrate concurrent validity against a reference standard for discriminating between meaningful subgroups within LBP and its role in guiding clinical decision making. The presence of extreme values made it necessary to transform the clinical scores to produce a normal distribution for the statistical analysis. This does not affect the validity of the cutoff values and the clinical interpretation of individual test scores.

The trainability of the movement task is clinically relevant. The test could only discriminate between LBP and pain-free groups posttraining. This implies that training of the task is critical. Task performance improved with training in both groups. Although patients with LBP are able to change their motor behavior, the increment in the total score of the LBP group was approximately half that achieved by the pain-free group. As the training involved specific cognitive attention to movement and muscle activity (ie, cognitive skill training), the difference could be a consequence of deficits in proprioception or muscle function or may indicate a change in the ability of the group to learn a new task. Individuals with LBP may require longer and/or more intense training.

CONCLUSION

The assessment of control of spinal movements with the clinical test of thoracolumbar dissociation was related with kinematic measures. The test was able to identify a difference in control of the movement of the thorax relative to the pelvis between people with and without LBP. This preliminary study of concurrent and discriminant validity of the test also provides a foundation to further investigate its utility to characterise thoracolumbar movement patterns in individuals with LBP.

KEY POINTS

FINDINGS: A clinician’s interpretation of performance of a clinical test of dissociation of movement of the thorax and lumbopelvic region during forward/backward pelvic motion was related to...
objective measures of spine and pelvis kinematics.

**IMPLICATIONS:** There is variation in the ability to dissociate movement of the pelvis and thorax between individuals with and without LBP. Test scores might help characterize subgroups of patients with LBP and identify pain-free individuals at risk of future LBP. This proposition requires further testing.

**CAUTION:** This study provides initial validation of clinical evaluation of a patient's ability to dissociate movements of spine regions, with a single assessor not blinded to LBP status. Future research is required to determine the relevance of this test score for treatment selection.

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**REFERENCES**


