Reliability and Discriminatory Capacity of a Clinical Scale for Assessing Abdominal Muscle Coordination

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Abstract

Objective: This study evaluated the reliability and discriminatory capacity of a novel clinical scale for assessing abdominal muscle coordination. We investigated the interrater reliability of this tool in patients with chronic low back pain (LBP) (reliability section); the ability of this tool to discriminate healthy and LBP subjects (discriminatory section); and the association between the score and measures of pain, disability, and kinesiophobia (correlation section).

Methods: For the reliability section of this study, 14 patients with chronic LBP were included. For the discriminatory section, 10 patients with chronic LBP and 10 pain-free controls were recruited. In the correlation study, data from the 10 chronic LBP patients in the discriminatory section were used. The clinical test was conducted by a blinded examiner while the subjects attempted to independently activate transversus abdominis separate from the rest of the abdominal muscles (hollowing or draw-in maneuver). The intraclass correlation coefficients, receiver operating characteristic curve, and Pearson *r* correlation coefficients were calculated to assess reliability and validity.

Results: An intraclass correlation coefficient$_{(2,1)}$ of 0.72 (95% confidence interval, 0.33-0.90) was recorded for interrater reliability. The tool correctly identified the subject condition in 97% of the cases. The score did not correlate substantially with any clinical measures, with Pearson *r* ranging from 0.122 (P = .737) to 0.493 (P = .148).

Conclusions: This study showed that the proposed scale is a reliable tool and may be useful in discriminating patients with chronic LBP from pain-free controls. The poor correlation between the score and clinical measures may be due to the multidimensional nature of chronic LBP. (J Manipulative Physiol Ther 2011;34:562-569)

Key Indexing Terms: *Low Back Pain; Abdominal Muscles; Palpation*

When manual therapists assess patients with low back pain (LBP), clinical tests are frequently used to assess the function of deep abdominal muscles.[1] These assessment tools provide information that is likely to assist in the planning of treatment and to define prognosis.[2] Applying clinical tests in a systematic way is important to guarantee the tests results' reproducibility, allowing clinicians to document treatment efficacy and to communicate with one another.[3] Although clinical tests for assessing deep abdominal muscle function, such as the transversus abdominis muscle (TrA), are popular in clinical practice, their capacity to identify people with functional deficits remains controversial.

The palpation test,[4] pressure biofeedback unit test,[5] and Wisbey-Roth grading system[6] are clinical tests described in the literature to assess TrA function in patients with LBP. The assessment of TrA has been clinically advocated, as activation of this muscle contributes to the dynamic stability of the lumbar spine by tensing the thoracolumbar fascia[7,8] and increasing the intraabdominal pressure.[9] In addition, the onset of TrA activation before limb movements provides evidence of the role of this muscle in spinal stiffness generation.[10,11] However, the recruitment pattern of this muscles is altered in LBP with delayed onset of

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activity before arm and leg movements, higher threshold for activation, greater direction specificity,[9,10,12-14] and reduced increase in muscle thickness during leg movement.[15] Patients with LBP also have poor ability to reduce pressure in the pressure biofeedback unit, which is an air-filled pressure cuff that is placed under the prone patient's abdomen during the test.[5,16] Patients may compensate for reduced spinal stability by co-contracting superficial trunk muscles over TrA.[17] However, this compensatory strategy increases the load on spinal structures, with potential long-term consequences.[9,18,19] Because patients with LBP have deficits in TrA function, it is proposed that training of TrA should be incorporated in the initial stages of treatment.[4,19,20] Based on this principle, the motor control training approach has shown to be effective for treating patients with chronic LBP.[21,22] Furthermore, recent work[2] has shown that TrA function can be used as a predictor of success with motor control training. Patients with a poor baseline ability to recruit TrA have a greater reduction in pain when treated with motor control training compared with those with better TrA recruitment.[2]

Electromyography (EMG) using fine wire electrodes[10] is considered to be the criterion standard for the assessment of TrA recruitment. However, the high costs and complexity make the implementation of this tool in clinical settings difficult. Investigations concerning more clinically applicable methods, such as pressure biofeedback unit, show inconsistent reproducibility as well as false-positive results due to compensatory strategies.[23,24] The Wisbey-Roth grading system,[6] a clinical test based on manual palpation of deep stabilizing muscles, has also been shown to be unreliable.

In an attempt to quantitatively assess the independent control of TrA contraction, the authors have developed a clinical tool for assessing coordination of abdominal muscles: the Clinical scale for assessing Abdominal Muscle Coordination (CAMC). Although the CAMC scale was developed to assess abdominal muscle coordination, a more detailed investigation of its validity and reliability is required. Our view is that the ability to independently contract TrA with less superficial muscle participation may reflect the capacity to coordinate the system (local and superficial muscles). Accordingly, a valid and reliable tool would help physiotherapists test the coordination pattern of abdominal muscles and the changes in the coordination level with the implementation of specific stabilizing exercises in a simple and objective way. In addition, it is not known whether TrA recruitment measured by this tool is related to important clinical measures such as pain, disability, and kinesiophobia (fear of movement).

Therefore, this study had 3 purposes. We evaluated reliability, discriminatory capacity, and correlation of the CAMC; each section had a specific aim.

1. In the reliability section, the aim was to determine the interrater reliability of the CAMC scale.
2. In the discriminatory section, we investigated the ability of the CAMC scale to discriminate people with and without chronic LBP.
3. In the correlation section, the aim was to measure the association between the CAMC score and clinical measures of pain, disability, and kinesiophobia.

Methods

Participants

For the reliability section, 14 participants were recruited. This sample size allowed for an intraclass correlation coefficient (ICC) of 0.9 with 2 repeated measurements, $\alpha = 0.05$ and $\beta = 0.20$.[25] To be included in this section, participants needed to have a history of chronic LBP with restricted function activities (work and sport) in the past 12 months.

For the discriminatory section, 20 participants (10 with chronic LBP and 10 pain-free controls) were recruited. The sample size was calculated to detect a difference of 2 points in the CAMC scale, with SD = 1.0, $\alpha = 0.05$, and $\beta = 0.20$. For the control group, participants had to be between the ages of 18 and 60 years and had to have no previous history of chronic LBP that had restricted their function activities (work and sport) in the past 12 months. Subjects were excluded from both groups if they had any respiratory or neurological disorders or pain elsewhere in the spine or lower limbs or had been pregnant in the previous 2 years. Participants in the chronic LBP group had to have *chronic nonspecific LBP*, defined as pain lasting for at least 3 months, with or without pain referral to the leg, but without neurological deficit. To be included in this group, participants had to score at least 2 points on the Brazilian-Portuguese version of the Roland Morris Disability Questionnaire[26] and score at least 2 units on the 11-point visual analogue scale for pain.[27] Exclusion criteria for the chronic LBP group were spinal surgery in the past 12 months, being pregnant, suspected or diagnosed serious spine pathology (inflammatory spondyloarthropathies, fracture, malignancy, cauda equina syndrome, or infection), and nerve root compromise (diagnosed by at least 2 positive test results out of the following: deep tendon reflex tests, sensation tests, and muscle power tests). Potential subjects with a report of osteoarthritis, grade I spondylolysis/spondylolisthesis, disk protrusion, herniation, prolapse, or spinal stenosis remained eligible.

For the correlation section, data from all patients with chronic LBP (included in the discriminatory section) were used to measure the association between the CAMC score and clinical measures.

Participants were patients and staff members recruited from private physiotherapy clinics located in Belo Horizonte, Brazil. This study was conducted between