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Novel augmented ADIM training using ultrasound imaging and electromyography in adults with core instability

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Abstract. *Objective*: To determine the effect of novel augmented abdominal drawing-in maneuver (ADIM) training using rehabilitative ultrasound imaging (RUSI) and electromyography (EMG) in adults with core instability.
Methods: A convenience sample of 20 young adults with core instability (female = 4; mean age ± standard deviation = 24.4 ± 2.9 years) was recruited. Core instability was determined by the formal test. All subjects underwent an intensive ADIM that was augmented by comprehensive visual feedback via a pressure biofeedback unit, RUSI, and EMG. The intervention was provided for 20 minutes a day, 7 days a week, over a two-week period.
Results: The paired t-test showed that both transverse abdominal (TrA) and internal oblique (IO) muscle thickness during ADIM were significantly greater than at rest ($p = 0.000$). However, external oblique (EO) muscle thickness remained relatively unchanged. The mean EMG amplitudes of the EO and erector spinae (ES) muscles were significantly decreased after the intervention ($p = 0.001$, $p = 0.008$). The intra-class correlation coefficient ($ICC_{1,2}$) showed the excellent test-retest reliability for muscle thickness (ranging from 0.90 to 0.98 in the prone position).
Conclusion: This is the first evidence to demonstrate that the novel augmented ADIM training can effectively improve the lumbo-pelvic stabilization in adults with core instability.

Keywords: Low back pain, abdominal drawing-in maneuver, ultrasound, electromyography, transverse abdominal muscle

1. Introduction

Lumbo-pelvic core instability is a common neuromuscular impairment in individuals with low back pain (LBP) that is often manifested in a reduction in cross-sectional muscle fiber size [10] and altered motor recruitment patterns [20]. Neuromechanically, lumbo-pelvic core stability or stiffness is achieved by three subsystems: (1) passive (i.e., ligaments, capsules, surface geometry, and passive tension of muscle fibers – titin) (2) active (muscle contraction), and (3) neural control (i.e., sequence, amplitude). All three subsystems provide the proper loading on the lumbar spine to stabilize or stiffen the core system in response to the various demands during functional tasks or activities [16]. Particularly, the active and neural subsystems which are responsible for efficient neuromuscular control of the transverse abdominal (TrA) muscle during core stabilization are often impaired in patients with chronic LBP [20]. Recently, core stability exercise focusing on the selective activation of TrA is effective for improving lumbo-pelvic stability and pain reduction in individuals with LBP [2,20]. This selective core stabilization exercise may have facilitated restoring neuromuscular control in the impaired active and neural subsystems, thereby increasing lumbo-pelvic core stability

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