ISB 2015

Rehabilitation

ISB 2015-765

DOES THE ABDOMINAL DRAWING-IN MANEUVER CHANGE THE LOCAL DYNAMIC STABILITY OF REPETITIVE SPINE MOVEMENTS IN A HEALTHY POPULATION?

Daniel Southwell* [1], Nicole Hills[2], Linda McLean[2, 3], Ryan Graham[1, 4]

[1]School of Physical and Health Education, Nipissing University, North Bay, [2]School of Rehabilitation Therapy, Queen's University, Kingston, [3]School of Rehabilitation Sciences, University of Ottawa, Ottawa, [4]School of Kinesiology and Health Studies, Queen's University, Kingston, Canada

Preferred Presentation: Oral Presentation

If your abstract is not accepted as an oral do you wish to be considered for a poster?: Yes

Clinical Biomechanics Award: No

David Winter Young Investigator Awards: No

Emerging Scientific Award sponsored by Professor J De Luca: No

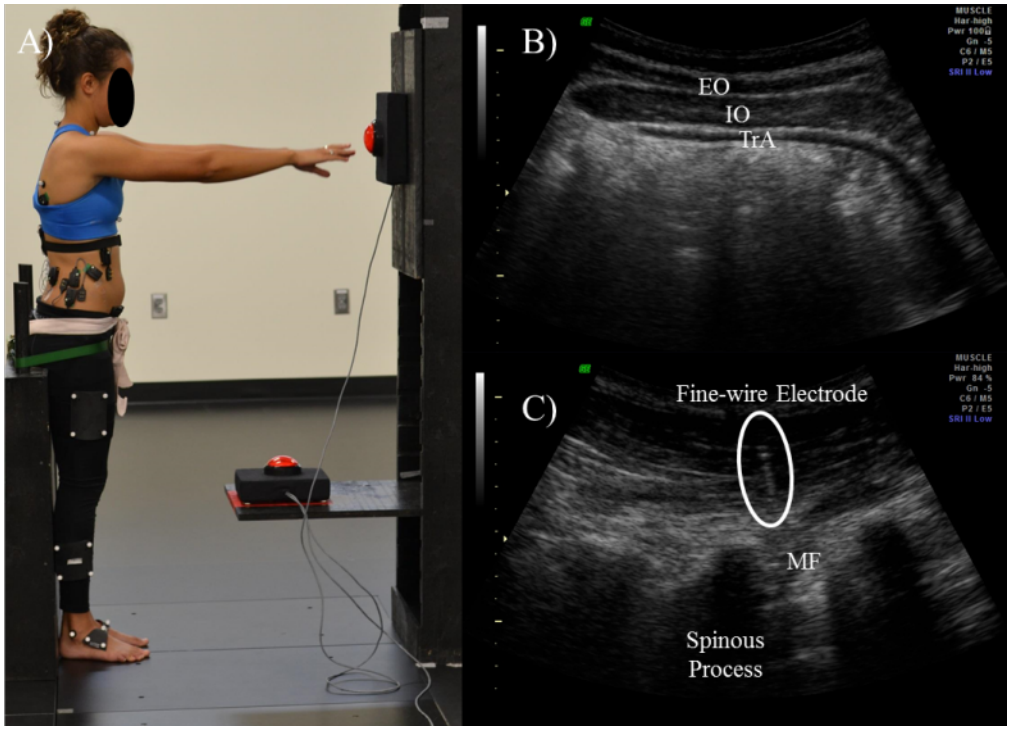
Promising Scientist Award sponsored by Motion Analysis: No

Introduction and Objectives: Selective activation of the transversus abdominis (TrA) through the abdominal drawing-in maneuver (ADIM), has been adopted as common clinical practice in the prevention and rehabilitation of low back pain (LBP) [1]. However, there is still a debate in regards to the role the ADIM has in maintaining a stable spine [2-3]. There is also limited evidence to support the use of the ADIM during dynamic movement tasks to enhance spine stability and currently no literature that shows spinal control is less optimal when activation of the TrA is changed [3]. Spinal control cannot be accurately tested in many current biomechanical models as few include contributions of intra-abdominal pressure and fascial tension [3]. One way to assess control and take into account all aspects of spine stability is to look directly at the outcome kinematics during repetitive movement using non-linear dynamic systems analyses [4]. Thus, the purpose of this study was to (i) examine whether TrA activation could be increased during dynamic movements following five minutes of training, and (ii) assess whether changes in TrA activation could alter dynamic spine control and stability.

Methods: Thirteen healthy participants (7M, 6F) performed two sets of 35 cycles of repetitive unloaded spine flexion with a constrained pelvis to the beat of a metronome at a rate of 15 cycles/min [4] (Figure 1). Between sets, participants were instructed by a Registered Physiotherapist on how to perform the ADIM in standing. Ultrasound (US) imaging (Voluson i, GE Health Care, UK) was used as biofeedback to ensure successful contraction of TrA. Surface EMG was recorded at 2000Hz from four muscles bilaterally: thoracic and lumbar erector spinae (TES and LES), and internal and external oblique (IO and EO) (Trigno, Delsys Inc., USA). Indwelling EMG was recorded synchronously from three muscles unilaterally (right side): IO, TrA, and multifidus (MF). Indwelling electrodes were inserted under US guidance to ensure correct positioning in each muscle (Figure 1). During all trials, 3-D kinematic data were collected at 50 Hz (Oqus 400+, Qualisys, Sweden), and Visual-3D was used to calculate 3-D spine kinematics (C-Motion Inc., USA). EMG data were processed and local dynamic spine stability was calculated using published methods [4]. The average peak EMG across all cycles and the local dynamic stability values were then compared between the baseline and trained trials using repeated-measures ANOVA's in SPSS 22 (IBM Corporation, USA).

Results: Average peak EMG and local dynamic stability results can be found in Table 1. Results indicate that following ADIM training, there were significantly greater ($p<0.05$) levels of activation in all of the tested abdominal muscles during movement. Conversely, there were no significant increases in activation of any of the back muscles tested. Moreover, no significant change in the local dynamic stability of spine movements was observed following training ($p=0.855$).

Figure:



Caption: Figure 1. A) Experimental set-up. B and C) Representative abdominal and lumbar spine ultrasound images.

Conclusion: The results indicate that in a healthy population, increasing activation of the TrA does not increase dynamic spinal control or stability. While this finding agrees with previous research [2], it may also be partly explained by participants' non-familiarity with activating their TrA during movement (although not reported, abdominal muscle activation variability was significantly greater during the trained trial). Previous literature has shown that focusing internally on the activation of a muscle rather than externally on the task at hand, can impair neuromuscular coordination and movement outcomes [5]. To assess such a motor learning effect, we are currently analyzing data from a second day of testing after participants performed a home exercise program of TrA activation and stabilization exercises for one week. Our future work will also investigate the effects of the ADIM on the dynamic stability of spine movements and TrA timing in LBP patients, since TrA training may be effective in reducing symptoms in such populations [3].

Table:

			Baseline		Trained		ANOVA
			Mean	SD	Mean	SD	p-value
Average Peak EMG (%MVC)	Indwelling	IO	9.8	(8.1)	18.4	(10.9)	**0.000**
		TrA	18.2	(15.7)	31.4	(18.9)	**0.001**
		MF	33.7	(21.9)	32.5	(31.4)	0.753
	Surface	R IO	12.9	(7.4)	34.3	(29.5)	**0.009**
		L IO	13.0	(7.9)	35.6	(20.6)	**0.000**
		R EO	4.5	(3.2)	12.9	(8.7)	**0.001**
		L EO	3.6	(2.0)	8.9	(5.8)	**0.002**
		R LES	31.5	(15.2)	31.0	(13.3)	0.705
		L LES	33.8	(13.5)	33.9	(14.0)	0.970
		R TES	20.6	(8.6)	21.1	(12.1)	0.794
		L TES	20.9	(8.8)	21.0	(10.5)	0.941
Dynamic Stability (λ_{max})			2.12	(0.19)	2.11	(0.19)	0.855

Caption: Table 1. EMG and dynamic stability mean (standard deviation) and ANOVA results. Bolded values indicate significance at $p<0.05$.

References: [1] Richardson et al., Spine., 27: 399-405, 2002.

[2] Grenier et al., Arch. Phys. Med. Rehabil., 88: 54-62, 2007.
[3] Hodges. P., Br. J. Sports Med., 42: 941-944, 2008.
[4] Graham et al., J. Biomech., 47: 1459-1464, 2014.
[5] Lohse et al., Acta Psychol., 140: 236-245, 2012.

Disclosure of Interest: None Declared