Lower Trunk Muscle Endurance and Core Testing: A Literature Review
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ABSTRACT

Introduction: Muscle endurance refers to ability of a muscle or group to repeatedly move against a sub maximal resistance. Lack of endurance of trunk muscles has been identified as a predictor of first-time occurrence of low back trouble in men. Core is considered as power house of body. It provides proper force distribution and maximum force generation in whole kinetic chain. So the purpose of this review study is to explore & assess the tests available for lower trunk muscle endurance & core muscle.

Objectives: To review the literature that describes and evaluates the use lower back endurance & core muscle tests.

Design: Review of literature

Data collection: Relevant articles in English were retrieved through a search of MEDLINE and PubMed. Key search terms were lower back muscle endurance & core muscle assessment test. The principal criterions for inclusion were as follows: any study that discussed or tested lower trunk & core muscle endurance test. The tests used for rehabilitation protocol & test using stability ball related articles were excluded. Thirty-seven of the initial studies were included in this review.

Data Synthesis: Recent research, meta-analysis, clinical oriented first thirty literatures were taken in the study.

Results: So many different types of lower back endurance & core testing methods were found. Some of these procedures require special testing devices. Each muscle tests assessed for its reliability, normative data (gender specific, sports specific etc.) & its clinical significance.

Conclusion: In present study we found tests which are highly reliable, valid & also easy to asses abdominal & core muscle endurance. As they do not require any equipment nor extended periods of time to perform and would appear to be more clinically useful. Clinicians also need same tests which will allow them to evaluate a patient’s ability to perform low force repetitive type tasks that are more indicative of real world occupational duties.

Introduction

Lower back muscle endurance testing can help to predict and determine low back pain across the population. Practitioners not only require reliable and relevant tests, they also require tests that are easy to perform, require little or no specialized equipment, thus making them of more use in a clinical setting.
Endurance and strength in addition to proprioception of the low back are parameters that appear to be testable and predictable in patients with lower back complaints. Tests that are of a predictive nature for injury are useless once the injured patient is sitting in the practitioner’s office. Instead, tests that predict the outcome of a patient’s treatment or the extent of their injury are more clinically useful. The literature is vast and consequently involves vast amount of tests, comparisons and procedures. Core is like a box. In which, abdominals in the front, para spinals and gluteals in back, diaphragm makes roof, Pelvic Floor and hip girdle makes bottom (Richardson, C., G. Jull 2001). Without these muscles, the spine would become mechanically unstable with compressive forces as little as 90 N. a load much less than the weight of the upper body (Crisco Et al. 1992). When the system works as it should, the result is proper force distribution and maximum force generation with minimal compressive, translational, or shearing forces at the joints of the kinetic chain (Fredericson, 2005). The core is particularly important in sports because it provides “proximal stability for distal mobility” (Kibler, 2006). Prospective data have suggested a correlation between trunk and torso control and lower extremity injury. It is known that if the core is not stable, then the weaker links within the kinetic chain are at risk for injury. Therefore, core stability could lead to more efficient use of the kinetic chain. If the kinetic chain is efficient, then there is decreased chance of insufficiency that could result in dysfunction and injury.

Over the past two decades, lumbar spine stability has become an integral part of the low back pain assessment and treatment strategies. (Grenier SG, McGill SM, 2007). Numerous studies have shown a significant decrease in back extensor muscle endurance in patients with low back pain.  

Results

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<tr>
<th>Author</th>
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<tr>
<td>Swain C, Redding E, J Dance Med Sci., (2014)</td>
<td>Trunk muscle endurance and low back pain in female dance students.</td>
<td>Reduced trunk muscle endurance (p&lt;0.05) (the right and left side plank, double straight leg raise, and the Sorensen test) is present among dancers with LBP.</td>
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<td>Del Pozo-Cruz B et al., J Back MusculoskeletRehabil. (2014)</td>
<td>Reliability and validity of lumbar and abdominal trunk muscle endurance tests in office workers with nonspecific sub acute low back pain.</td>
<td>Prone and supine isometric lumbar and abdominal trunk muscle endurance tests appeared to be reliable (ICC 0.9) and valid measures in office workers with sub acute low back pain. (endurance test time significantly reduced (p&lt;0.05) in LBP patient)</td>
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<td>Sarah L. Strand, Journal of Human Kinetics volume (2014)</td>
<td>Norms for an Isometric Muscle Endurance Test</td>
<td>These normative percentiles for abdominal endurance suggest that the abdominal plank test can be used as an alternative to other abdominal assessments in college students where physical activity greater than 5</td>
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<tr>
<td>Parikh C et al., International Journal of Therapies and Rehabilitation Research 2015; 4 (4): 55-60</td>
<td>Flexion rotation trunk test to assess abdominal muscle endurance: reliability, learning effect, and sex differences</td>
<td>Times/week showed the greatest influence.</td>
<td>The FRT test is a reliable (ICC of 0.94) abdominal endurance field test. Extensive familiarisation (at least 3 trials) period is required.</td>
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<td>Brennelsen et al., J Strength Cond Res., (2013)</td>
<td>Intersession reliability and concurrent validity of isometric endurance tests for the lateral trunk muscles.</td>
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<td>FESS (.87) and TESS (.91) had comparable intersession reliability by the same evaluator.</td>
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<td>Martin Descarreaux et al. (2012)</td>
<td>Trunk muscle fatigue during a lateral isometric hold test: what are we evaluating?</td>
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<td>Ipsilateral external oblique and contralateral L5 erector spinae show signs of muscle fatigue. It should be taken as general trunk muscle endurance test &amp; measures stabilisation capacity of trunk.</td>
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<td>Roland Müller et al. (2010)</td>
<td>Isometric back muscle endurance: An EMG study on the criterion validity of the Ito test (29 healthy subjects)</td>
<td></td>
<td>The iliocostalis (p = 0.006) and the multifidi muscles (p = 0.03) significantly contributed to predict holding time in the Ito test. Ito test might present a valuable alternative for testing back muscle endurance in LBP patients.</td>
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<tr>
<td>Christian Larivière et al., (2009)</td>
<td>Toward the development of predictive equations of back muscle capacity based on frequency- and temporal-domain electromyographic indices computed from intermittent static contractions</td>
<td></td>
<td>It appears possible to predict the capacity of back muscles using an intermittent and time-limited (submaximal) fatigue task.</td>
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<td>Wolfgang Gruther et al., Journal of rehabilitation medicine (2009)</td>
<td>Diagnostic Accuracy And Reliability Of Muscle Strength And Endurance Measurements In Patients With chronic low back pain. (22 patients with chronic low back pain, 19 healthy controls and 15 patients with chronic headache)</td>
<td></td>
<td>Biering-Sørensen test demonstrated excellent accuracy (AUC = 0.93) and no learning effects. Dynamometric trunk muscle measures are limited to muscle function assessment purposes</td>
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<td>Rebecca J. Dennis et al. (2008)</td>
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<td>Stewart M et al., J Electromyography &amp; Kinesiol, (2008)</td>
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<td>(A cross-sectional analytic study)</td>
<td>Assessment of the validity of the Biering-Sørensen test for measuring back muscle fatigue based on EMG median frequency characteristics of back and hip muscles.</td>
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<td>Christophe Demoulin et al., (2007)</td>
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<td>(Literature Review)</td>
<td>Spinal muscle evaluation in healthy individuals and low-back-pain patients: a literature review</td>
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<td>Arab et al., Clinical Rehabilitation, (2007)</td>
<td>24</td>
<td>(Cross-sectional non-experimental)</td>
<td>To describe the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of five clinical tests used to measure trunk muscle endurance in low back pain.</td>
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<td>Raymond Leung et al. (2005)</td>
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<td>Assessment of a commercial abdominal exercise device and curl up exercise: A comparative EMG analysis</td>
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<td>Kerrie Evans et al. (2005)</td>
<td>27</td>
<td>(Longitudinal prospective study)</td>
<td>Predictors of low back pain in young elite golfers: A preliminary study, Physical Therapy in Sport</td>
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**Discussion**

Sorensen test for trunk muscle endurance is highly tested in terms of its reliability, validity & also accuracy. Sorensen test have negative correlation with age, percentage of body fat & weight. During performance of Sorensen test tester must cautious about increase in lumbar lordosis. Low endurance time in Sorensen test is considered as predictor of first time occurrence of LBP in men. We also found Ito test, which was easy to perform, put less spine loading, limit the risk of lumbar hyper lordosis as compared to the Sorensen test. 28 Another useful trunk endurance test was Side bridge test. The difference between left and right endurance time in side bridge test would predict who is at greater risk of back problem. Discrepancy of .05 from rt to lt side holding time ratio would suggest unbalanced endurance (McGill et al., 2003). 29 It should taken as general trunk muscle endurance & measures stabilisation capacity of trunk. E.g. quadrates lumborum,

external oblique, rectus abdominis, lumbar and thoracic erector spinae, gluteus medius, lumbar multifidus, glutaeus maximus and hamstrings. The test have good inter session reliability. Age & sex considered while interpreting result. The optimal values in this test prevent LBP in golf players.

The Ito test, also known as the prone extension test (PET), was examined by Muller et al.2010, to determine its validity and reliability in comparison to the Sorensen test. They attempted to standardize the Ito test in order to remove any variability in test set up for future studies utilizing this test. They found an increased activation of the biceps femoris and semitendinosis in the Sorensen test when compared to the Ito test. However, the Ito test had higher illocostal muscular activity. They therefore concluded that the Ito test might assess back muscle endurance more specifically then the Sorensen test, thus indicating that the Ito test may be a superior test for assessing low back pain patients.

Lariviere et al., 2009 utilized a functional endurance test (FET) with repeated cyclic intermittent back extensions held for 8 seconds per cycle. Their results supported the validity of the FET and demonstrated that it has the potential to better assess the strength endurance capacity of CLBP relative to conditions more specific to common occupational tasks.

Lariviere et al., 2009 looked at the ability to predict back muscle absolute endurance and strength with the use of EMG signals collected during a FET. They determined that it appears to be possible to predict the capacity of back muscles using an intermittent and time-limited (sub-maximal) fatigue task. Therefore, this FET may have the potential to better infer back muscle capacity for realistic occupational tasks, as more specific muscle fatigue mechanisms are involved.

As per recent research FRT (Flexion Rotation) test should be included in trunk muscle endurance assessment. With Extensive familiarisation (at least 3 trials) period the FRT (Flexion Rotation) test is a reliable (ICC of 0.94) to assess abdominal muscle endurance as a valid field test.

Conclusion
In present study we found tests which are highly reliable, valid & easy to assess abdominal & core muscle endurance. As they do not require any equipment nor extended periods of time to perform and would appear to be more clinically useful. Clinicians also need same tests which will allow them to evaluate a patient’s ability to perform low force repetitive type tasks that are more indicative of real world occupational duties.

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References