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The development and reliability of a simple field based screening tool to assess core stability in athletes

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ABSTRACT

Objectives: To adapt the trunk stability test to facilitate further sub-classification of higher levels of core stability in athletes for use as a screening tool. To establish the inter-tester and intra-tester reliability of this adapted core stability test.
Design: Reliability study.
Setting: Collegiate athletic therapy facilities.
Participants: Fifteen physically active male subjects (19.46 ± 0.63) free from any orthopaedic or neurological disorders were recruited from a convenience sample of collegiate students.
Main outcome measures: The intraclass correlation coefficients (ICC) and 95% Confidence Intervals (CI) were computed to establish inter-tester and intra-tester reliability.
Results: Excellent ICC values were observed in the adapted core stability test for inter-tester reliability (0.97) and good to excellent intra-tester reliability (0.73–0.90). While the 95% CI were narrow for inter-tester reliability, Tester A and C 95% CI's were widely distributed compared to Tester B.
Conclusions: The adapted core stability test developed in this study is a quick and simple field based test to administer that can further subdivide athletes with high levels of core stability. The test demonstrated high inter-tester and intra-tester reliability.

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1. Introduction

Adequate core stability can be defined as the ability to stabilise the spine through integration of the passive spinal column, active spinal muscles and the neural control unit during daily activities and sporting movements (Hibbs, Thompson, French, Wrigley, & Spears, 2008; Liemohn, Baumgartner, & Gagnon, 2005; Faries & Greenwood, 2007). While few studies have conclusively displayed an increased injury rate in those with poor core stability (Zazulak, Hewett, Reeves, Goldberg, & Cholewicki, 2007; Leetun, Ireland, Willson, Ballantyne, & Davis, 2004), it has theoretically been proposed that poor core stability may affect injury rates as it can cause an unstable proximal base, due to the attachment of load transfer muscles at the spine and pelvis (Bliven & Anderson, 2013). Therefore, when high loads are placed on the body during daily activities and sporting movements, the control of the spine is reduced and the positioning of the spine and lower extremity can be altered which may predispose the player to injury (Bliven & Anderson, 2013; Cowley & Swensen, 2008; Cowley, Fitzgerald, Sottung, & Swensen, 2009; Nesser, Huxel, Tincher, & Okada, 2008).

No gold standard core stability test for use in a pre-participation screening, is available at present, and various core stability tests are proposed including: the front abdominal power test (FAPT), side abdominal power test (SAPT), McGill protocol isometric flexor endurance, McGill protocol isometric extensor endurance, McGill protocol isometric side bridge, plank to fatigue, double leg lowering test and trunk stability test (Cowley & Swensen, 2008; McGill, Childs, & Liebenson, 1999; Cowley et al., 2009; Krause, Youdas, Hollman, & Smith, 2005; Cook, Burton, & Hoogenboom, 2006). However, these tests are not considered ideal for use in a screening for a number of reasons. Firstly the FAPT and SAPT tests measure core strength, despite Cowley and Swensen (2008) stating they are a measure of core stability. The isometric McGill and plank to fatigue tests are completed in a single stationary position, which does not reflect the demands placed on the core during most sporting

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movements (Nesser et al., 2008) and also take a significant amount of time to complete. The tests also have vague or unclear scoring systems and can require expensive equipment or necessitate therapists to develop or build equipment, particularly the double leg lower test, and McGill isometric flexor and extensor endurance tests. The development of a gold standard test for core stability is challenging because not only is there no widely accepted conclusive definition of core stability, there are numerous different muscles that assist in core stability and the interaction between the muscles of the lumbo-pelvic-hip is complex, hence it is difficult for researchers to develop a single test that incorporates all muscles and structures (Cowley & Swensen, 2008; Cowley et al., 2009; Hibbs et al., 2008). Despite these challenges, there is a clear need to develop a quick, simple, valid and reliable test to accurately establish core stability in a participant, which can be easily administered by therapists and utilises minimal inexpensive equipment.

The trunk stability push up test is one of the seven tests utilised to assess fundamental movement in the Functional Movement Screen (FMS™) (Cook et al., 2006). It is proposed that the trunk stability push up test measures reflex core stabilisation and requires participants to complete a closed kinetic chain, upper body symmetrical pushing movement (push up) while controlling and limiting movement of the spine and hips in the sagittal and anterior/posterior plane (Cook, 2010). Thus, it assesses core stability under functional loading during dynamic movement, which is beneficial as dynamic motion occurs during sporting movements and therefore is more applicable for use in a screening or clinical setting (Bliven & Anderson, 2013; Chorba, Chorba, Bouillon, Overmyer, & Landis, 2010). In addition this test requires minimal equipment and can easily be administered in a field based setting by therapists. While this test has some obvious advantages (quick to administer, requires no equipment, easy to implement, dynamic nature of the test), the trunk stability push up test may not be sensitive enough to differentiate between the subtle differences between good and excellent core stability, especially in the athletic population where core stability is seen by many coaches and athletes as advantageous. It has been demonstrated that 76.2% of young physically active males achieved the highest rating of three in this test (Schneiders, Davidsson, Hörman, & Sullivan, 2011), therefore when implementing a screening with athletes, it may be difficult to sub-classify those with higher levels of core stability utilising this trunk stability push up test. Butler, Plisky, and Kiesel (2012) attempted to increase the precision of the FMS, and generated the 12 point scoring for the trunk stability push up test, with the previous rating of 3, 2 and 1 equalling a score of 12, 5 and 0 respectively. However, the addition of an extra level to this test in order to incrementally challenge the core stability of an athlete may allow further subdivision of the grading system and so identify those with higher core stability. Slightly reducing the base of support to cause light to moderate instability during the test, may require the core muscles to further stabilise and so implement a greater challenge to the participant (Stanton, Reaburn, & Humphries, 2004; Haynes, 2004). Thus the aim of this study was to adapt the trunk stability push up test in order to make the test more challenging to the athletic population and allow further differentiation between good and excellent scores.

The reliability of this adapted test is critical in order to accurately interpret the results of this test. Establishing both the inter-tester reliability (the amount of agreement between measurements taken by different testers) and intra-tester reliability (consistency of a tester to capture the same test result when repeated across testing sessions) is important to ensure any improvement or deterioration of core stability noted in the test is not due to the unreliability of the test itself. Therefore the current study aims to establish the inter-tester and intra-tester reliability of this adapted test.

2. Materials and methods

2.1. Development of test

The four authors of the study (a clinical biomechanist, a sports medicine physician and two certified athletic rehabilitation therapists), with extensive experience in the clinical and screening setting, adapted the trunk stability test to design the "alternative trunk stability push up test". Content validity was established by holding a number of meetings to discuss methods of adapting the trunk stability push up test in order to introduce an increased level of difficulty to this test, while still ensuring the test was easy to execute and accurate. The experts proposed a number of different methods of adapting this test, including, reducing the base of support to the lower extremity, upper extremity and the introduction of an unstable surface, but ultimately voted until a 100% agreement was reached on which adaptation was ideal. Reducing the base of support by lifting one arm was problematic as some participants found they could not complete the push up with one arm due to poor upper body strength. The addition of an unstable base was also challenging as it would require testers to purchase and transport further equipment to complete the test, which contradicted the ultimate goal of the development of a quick, easy to use screening test that utilised minimal equipment. Thus reducing the base of support by lifting one leg was voted as the optimal adaptation, and the right leg was chosen for standardisation purposes. A pilot study was completed ($n = 15$) by the principal investigator to assess the feasibility of the test in differentiating between those with good and excellent core stability, to ensure the instructions were easy to understand and to confirm the test was simple to execute and score. The pilot study found that 80% of participants scored a 3 (the highest score) in the trunk stability push up test. When the alternative trunk stability push up test was then implemented, 53.3% were reported to have good core stability and received a score of three, and 26.7% scored an excellent and received a score of 4 (the highest score).

2.2. The alternative trunk stability push up test

The only equipment required in the alternative trunk stability push up test is a straight line of athletic tape placed along the floor which was used to indicate where subjects must place their hands. The tester completed a demonstration of the test after reading the instructions, as the pilot study demonstrated that this assisted the subjects understanding of how to complete the test. A 0–4 rating was given by the tester (Table 1), with the higher the rating, the better the core stability displayed by the subject. To begin the test, the subject is instructed to lie with their face towards the floor with their feet together, hands shoulder distance apart and forehead at the level of the athletic tape. The subject is asked to lift their right leg slightly off the ground to reduce their base of support. The subject is then required to complete a press up while lifting the body as a unit with a straight line between the shoulder, hip and knees with no lag or twisting of the spine or hips and keeping the right leg slightly up off the ground (Fig. 1). If the subject can complete this movement, they receive a rating of 4. If they are unable to complete the test sufficiently they are required to repeat the test again with both feet on the ground and their hands at the level of the forehead. If they are able to sufficiently do this they receive a score of 3. If they are unable to complete the test sufficiently with their hands at the level of the forehead, they must repeat the test with their hands at the level of their chin. If they can

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