Abstract: The use of instability devices and exercises to train the core musculature is an essential feature of many training centres and programs. It was the intent of this position stand to provide recommendations regarding the role of instability in resistance training programs designed to train the core musculature. The core is defined as the axial skeleton and all soft tissues with a proximal attachment originating on the axial skeleton, regardless of whether the soft tissue terminates on the axial or appendicular skeleton. Core stability can be achieved with a combination of muscle activation and intra-abdominal pressure. Abdominal bracing has been shown to be more effective than abdominal hollowing in optimizing spinal stability. When similar exercises are performed, core and limb muscle activation are reported to be higher under unstable conditions than under stable conditions. However, core muscle activation that is similar to or higher than that achieved in unstable conditions can also be achieved with ground-based free-weight exercises, such as Olympic lifts, squats, and dead lifts. Since the addition of unstable bases to resistance exercises can decrease force, power, velocity, and range of motion, they are not recommended as the primary training mode for athletic conditioning. However, the high muscle activation with the use of lower loads associated with instability resistance training suggests they can play an important role within a periodized training schedule, in rehabilitation programs, and for nonathletic individuals who prefer not to use ground-based free weights to achieve musculoskeletal health benefits.
Canadian Society for Exercise Physiology Position Stand on
THE USE OF INSTABILITY TO TRAIN THE CORE
IN ATHLETIC AND NON-ATHLETIC CONDITIONING

David Behm¹
Eric Drinkwater²
Jeffrey M. Willardson³
Patrick M Cowley⁴

¹School of Human Kinetics and Recreation
Memorial University of Newfoundland
St. John's, Newfoundland, A1C 5S7, CANADA

²School of Human Movement Studies
Charles Sturt University
Panorama Avenue, Bathurst, 2795, NSW AUSTRALIA

³Kinesiology and Sports Studies Department
Eastern Illinois University
Charleston, Illinois, 61920, USA

⁴Department of Exercise Science
Syracuse University
Syracuse, New York 13207, USA

Corresponding Author:

David Behm PhD
Associate Director of Graduate Studies and Research
School of Human Kinetics and Recreation
Memorial University of Newfoundland
St. John's, Newfoundland, Canada, A1C 5S7
709-737-3408 (phone)
709-737-3979 (facsimile)
dbehm@mun.ca

Running Head: Training the Core
ABSTRACT

The use of instability devices and exercises to train the core musculature is an essential feature of many training centres and programs. It was the intent of this position stand to provide recommendations regarding the role of instability in resistance training programs designed to train the core musculature. The core is defined as the axial skeleton and all soft tissues with a proximal attachment originating on the axial skeleton, regardless of whether the soft tissue terminates on the axial or appendicular skeleton. Core stability can be achieved with a combination of muscle activation and intra-abdominal pressure. Abdominal bracing is shown to be more effective than abdominal hollowing to optimize spinal stability. Although core and limb muscle activation are reported to be higher with similar exercises performed under unstable versus stable conditions, similar or higher core muscle activation can also be achieved with ground based free weight exercises such as Olympic lifts, squats and dead lifts. Since the addition of unstable bases to resistance exercises can decrease force, power, velocity and range of motion, they are not recommended as the primary training mode for athletic conditioning. However, the high muscle activation with the use of lower loads associated with instability resistance training suggests they can have an important role within a periodized training schedule, rehabilitation programs and for non-athletic individuals who prefer not to use ground based free weights to achieve musculoskeletal health benefits.

Key Words: resistance training, trunk muscles, back, balance, stability
RATIONALE

Training of the core musculature is an important facet and has gained renewed emphasis in the scientific and professional literature as well as sports training and rehabilitation fields. For the average healthy individual, training the core musculature is emphasized to maintain musculoskeletal health, especially related to the prevention of low back pain (Behm and Anderson 2006). For the injured individual, training the core musculature is used to treat and rehabilitate trunk-related musculoskeletal injuries (Caraffa et al. 1996; Cumps et al. 2007; Forestier and Toschi 2005). For the athletic individual, training the core musculature is not only advocated for the prevention of injury but also to enhance performance (Behm and Anderson 2006). According to the principle of training specificity (Behm 1995; Behm and Sale 1993), and since motion for some sports may occur on relatively unstable surfaces (e.g. skiing, snowboarding), training must attempt to closely address the demands of the sport. Instability based exercises are a very popular means of attempting to address this aspect of sports performance. A significant body of scientific knowledge has evaluated the role of instability in resistance training programs designed to train the core musculature.

The anatomical core is defined as the axial skeleton and all soft tissues with a proximal attachment originating on the axial skeleton, regardless of whether the soft tissue terminates on the axial or appendicular skeleton (Behm et al. 2009). Achieving sufficient spinal stability represents the complex interaction of passive (i.e. spinal ligaments, intervertebral discs, and facet articulations) and active muscle and neural subsystems (Panjabi 1992) and thus a single muscle or structure cannot be identified as the most important spinal stabilizer. The combination of core muscles recruited is dependent on the task demands (i.e. posture, external forces).

The global axial skeleton stabilizers include the large, superficial muscles (e.g. rectus
abdominis, external oblique abdominis, erector spinae group) that provide multisegmental stiffness over a greater range and also act as prime movers during dynamic activities (Behm et al. 2009). Other core muscles might be considered axial-appendicular transfer muscles that connect the trunk (i.e. axial skeleton) to the upper and lower extremities (i.e. appendicular skeleton) via the pelvic girdle and shoulder girdle, respectively (Behm et al. 2009). These core muscles function in transferring torques and angular momentum during performance of integrated kinetic chain activities, such as throwing or kicking (Cresswell and Thorstensson 1994; Kibler et al. 2006; Willardson 2007). Weakness in the core musculature may interrupt the transfer of torques and angular momentum resulting in decreased performance.

Spinal stability is dependent on the appropriate combination and intensity of muscle activation and the generation of intra-abdominal pressure. Abdominal bracing appears to be more effective than abdominal hollowing to optimize spinal stability (Grenier and McGill 2007). Specific training practices aimed at targeting the spinal stabilizing muscles (core) is an important consideration for activities of daily living, athletic performance and the rehabilitation of low back pain (LBP) (Abenhaim et al. 2000).

Instability applied to resistance training provides differing responses as compared to training under stable conditions. Performing resistance exercises on unstable surfaces is reported to increase activation of the core musculature versus performing the same exercises under stable conditions, whether the instability is derived from a platform (Anderson K. and Behm 2004; Anderson and Behm 2005; Marshall and Murphy 2006b; Santana et al. 2007) or the movement of the limbs (Gaetz et al. 2004; Holtzmann et al. 2004; Marshall and Murphy 2006a).

However, unilateral resisted actions (whether ground based or supported on an unstable base) can also provide a disruptive moment arm (torque) to the body, thus providing an
additional means of increasing the core musculature (Behm et al. 2003). Exercises performed on unstable surfaces not only can increase core muscle activation but also limb muscle activation (Anderson and Behm 2005; Marshall and Murphy 2006a; Marshall and Murphy 2006b) and co-contractions (Behm et al. 2002). However, other research demonstrates that ground based lifts such as squats and dead lifts provide even higher core activation than callisthenic style exercises performed on unstable surfaces (Hamlyn et al. 2007). Furthermore, unstable resisted actions can result in decreased force (Anderson K. and Behm 2004; Behm et al. 2002; McBride et al. 2006), power (Drinkwater et al. 2007; Kornecki and Zschorlich 1994), velocity and range of motion (Drinkwater et al. 2007). Resistance trained individuals with years of experience performing ground based free weight lifts may not respond with higher activation of the core musculature when performing exercises upon moderately unstable bases (Wahl and Behm 2008). Training programs must be structured so that athletes are prepared for the wide variety of postures and external forces encountered during sports participation. This is best accomplished through performance of a wide variety of exercises that encompass all planes of movement and varying loads.

**RECOMMENDATIONS**

**Athletes**

Athletes training for maximal strength, power and velocity of movement should emphasize higher intensity ground based lifts (i.e. Olympic lifts, squats, dead lifts and others) and not limit the training program to instability based resistance exercises. Because spinal stability is required for efficient execution of sports skills; a comprehensive program should include resistance exercises that involve a destabilizing component. The destabilizing component may involve instability devices but can also be achieved with ground based free
weights that provide a destabilizing torque to the centre of gravity. Specific training of the core musculature should be periodized just as any other component of athletic development.

Rehabilitation

From a rehabilitation standpoint, the utilization of unstable devices has been shown to be effective in decreasing the incidence of low back pain and increasing the sensory efficiency of soft tissues that stabilize the knee and ankle joints. Such training may promote agonist-antagonist co-contractions with shorter latency periods that allow for rapid stiffening and protection of joint complexes. From a performance standpoint, unstable devices should not be utilized when hypertrophy, absolute strength, or power is the primary training goal as force generation, power output and movement velocity are impaired and may be insufficient to stimulate the desired adaptations, especially in trained athletes.

General Population

For fitness and health conscious individuals and athletes at all levels (i.e. recreational to elite), ground based free weight lifts (e.g. back squat, deadlift, Olympic lifts, and others that involve trunk rotation) should form the foundation of exercises to train the core musculature. Such closed chain lifts are characterized by moderate levels of instability that allow for the simultaneous development of upper and lower extremity strength, thereby addressing all links in the kinetic chain. Open chain isolation exercises for the core musculature (e.g. trunk flexion either supported on stable or unstable surface) might be most useful for localized muscular endurance development or for aesthetic related goals (e.g. bodybuilding). Development of power, absolute strength, or localized muscular endurance can potentially contribute to increased spinal stability if incorporated through specific practice of relevant sports skills. Based on the relatively high proportion of type I fibers, the core musculature might respond particularly well
to multiple sets that involve high repetitions (e.g. > 15 per set). However, the characteristics of a
given sport may necessitate repetition ranges that emphasize strength and power development
(e.g. < 6 per set).

In conclusion, ground based free weight lifts are highly recommended for athletic
conditioning of the core musculature as they can provide the moderately unstable environments
to augment core and limb muscle activation while still providing maximal or near maximal force
and power outputs. However the concept of periodization illustrates the need to modulate
volumes and intensities of training over time and thus during phases involving lower loads,
instability training devices and exercises can stimulate high muscle activation. Individuals who
are involved with rehabilitation, health-related fitness pursuits or cannot access or are less
interested in the training stresses associated with ground based free weight lifts, can also receive
beneficial resistance training adaptations with instability devices and exercises to achieve
functional health benefits.
Reference List


