



The Truth on Fitness: **Should We Use Unstable Surfaces?**

Paul M. Juris, Ed.D.
Executive Director, CYBEX Institute





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Physioballs, balance boards, tilt disks, foam rollers and pads, inflated rubber disks, and Bosu's™ are all objects conspicuously placed around the floors of virtually every gym. Collectively, they comprise a class of exercise known as unstable training.

The rationale behind unstable surfaces is that the sudden, inconsistent motion stimulates sensory nerves in the muscles and joints, leading to more rapid acquisition of sensory information, and more efficient and effective processing by the central nervous system (Gruber and Golhoffer, 2004).

Additionally, moving surfaces induce muscles on opposite sides of a joint ("opposing muscle groups") to contract simultaneously. This is referred to as "co-contraction." Some degree of co-contraction generally occurs during all movements, as a protective measure of joint stability. When elevated levels of co-contraction occur, meaning that opposing muscles are working at nearly the same high level of intensity, the result is an increase in joint stiffness, with a stabilizing effect.

Muscular co-contraction is particularly useful in the clinical treatment of chronic ankle instability (Osborne, et al, 2001) and lumbar spine injury (McGill, 2001), where high levels of muscle co-activity help to improve joint stability (Behm, et al, 2005; Cosio-Lima, et al, 2003; Marshall and Murphy, 2005).

Like many clinical applications, physioballs, mobile ankle platforms, and the like, have been adopted for use in the fitness industry. But the original context and intent of these applications seemingly have been dismissed in favor of using them for, well, virtually everything, from upper and lower body strength training practices, to core training exercises, and even sports performance enhancement programs.

The question is, do any of these methods deliver real benefits beyond that which they were originally intended? Surprisingly, or perhaps not, depending on one's point of view, there is little evidence in support of many of today's unstable training practices, leading one to wonder whether these activities are suitable for general fitness or athletic populations.

A common fitness theory, for example, is that performing a vertical movement, like a military press, while sitting or standing on a ball, Bosu™, or other unstable surface, increases core muscle activation. To address this, Behm and colleagues (2005) and Lehman, et al (2005) monitored activity in the abdominal and spine

erector muscles during overhead dumbbell presses, while subjects were seated on either a physioball or stable bench. The authors found no difference in muscular activation levels between the two surface conditions.

The reason for this is simple; balanced vertical forces, which are aligned with the spine, do not prompt higher levels of core activity, regardless of surface stability. Asymmetrical loads, on the other hand, as in performing the overhead press with just one arm, do increase core muscle activity, but as noted by Behm et al, this would be equally true of stable as unstable surfaces. Thus, unstable platforms offer no additional advantage.

One could, instead, move one's limbs horizontally, which increases core muscle activity by applying perpendicular forces to the trunk (Cartas et al, 1993; Pope et al, 1986). Hodges and colleagues (1997, 1997) examined this during standing postures, and demonstrated enhanced core muscle activity with horizontal movements of the arms and legs, but none of the subjects was perched on an unstable surface, meaning that core muscle activation can occur effectively without a wobbly base. Consequently, there is still little compelling evidence to suggest that these types of movements performed on a labile surface will activate the core more effectively than on a solid base.

So how is core muscle activation accomplished during lumbar stabilization routines? The answer can be found in the subject's posture. Instead of a vertical posture with vertical or horizontal motion, exercises on balls that increase core muscle activity involve horizontal positions, either face up or face down on the ball.

It has been fairly well documented, for instance, that spine extensor exercises, while face down on a ball, activate the spine erector muscles more than the same exercises done on the ground (Cosio-Lima et al, 2003; Marshall and Murphy, 2005). The same can be said for abdominal crunches and bridging exercises. Some authors have even noted enhanced core activity during push-ups and bench presses on a ball, as opposed to a stable bench (Cowley, et al, 2007; Lehman, et al, 2006; Marshall and Murphy, 2006). All of these studies lead to the conclusion that core musculature can be better stimulated on unstable platforms when the subject is positioned horizontally on top of the moving surface, most likely by inducing higher levels of co-contraction around the spine.

The fact that core muscles can be further stimulated while doing bench presses or push-ups on a ball leads to another question. Can the same be true about shoulder and arm muscles? Several studies have looked at upper body muscle activity during either bench presses (Marshall and Murphy, 2006) or push-ups (Lehman, et al, 2006; Lehman, et al, 2008) on a physioball. But the conclusions, this time, were somewhat conflicting, and far less optimistic.

Marshall and Murphy, for example, did indicate an increase in deltoid activity during a bench press on the ball, but showed that the triceps were more active while on a stable bench. Lehman and associates (2006), on the other hand, demonstrated heightened triceps activity while doing push-ups on a ball, instead of the ground, thus raising some level of controversy. Despite this minor conflict, however, the authors did reach consensus in one critical area; that the addition of an unstable surface did not increase muscle activity in the pectorals or the scapula stabilizers, two critical muscle groups for shoulder joint function.

Additionally, studies examining the effects of unstable surfaces on the biomechanics of exercises further question the utility of these practices. Koshida, et al (2008), for instance, measured the velocity, force, and power of a barbell bench press with subjects positioned on a stable bench, or unstable physioball. The authors reported that all three variables were significantly greater when subjects performed the movements on a stable surface.

These findings are echoed for lower body activities as well, as studies have revealed a 45% reduction in peak force and a 40% deficit in rate of tension development for the squat (McBride, Cormie, and Deane, 2006), and a remarkable 70% lower force production for leg extension (Behm, et al, 2002), all while on unstable surfaces. Clearly, unstable surfaces have an inhibitory effect on force productivity.

Ultimately, the true measure of the efficacy of any protocol is its ability to improve performance in goal-oriented tasks. Unfortunately, in this domain, unstable surfaces are equally ineffective. As an example, Cressey and associates (2007) measured the effects of ten weeks of lower body training on specific athletic performance indicators. Subjects engaged in deadlifts and lunges on the ground or on inflated rubber disks, and were tested before and after training on jumping, 10- and 40-yard sprint times, and a t-test agility assessment.

On jumping tasks, the stable training group demonstrated significant improvements after the training regimen, while the unstable group showed no improvement at all. Both groups improved running times on the 10- and 40-yard sprints, but the stable group's improvement was, on average, twice as great as the unstable group's. Unstable training did help to improve agility test scores, but no better than stable training. The authors concluded that the use of unstable platforms "attenuates performance improvements in healthy, trained athletes."

These are not atypical findings. Stanton and colleagues (2004), for instance, showed an increase in core muscle stability after 6 weeks of physioball training, but no improvement in running economy. Further, Cowley et al (2006), cited earlier as having demonstrated enhanced core muscle activity during a physioball bench press, reveal an even more curious finding. Their subjects were given an abdominal power test in which they had to perform a dynamic sit up while tossing a medicine ball from overhead. Despite the fact that unstable

training resulted in a greater activation of the core musculature, stable core training resulted in a significantly longer medicine ball toss, i.e., better performance.

It is reasonable to conclude, therefore, that training on unstable surfaces does not result in substantive improvements in force production or performance on functional tasks, despite enhanced muscle activation. This conclusion brings to light a very important point; that there is not, necessarily, a correlation between muscle activity and performance.

Let's consider, once again, the basic premise of unstable surfaces. The increased mobility of the surface results in high levels of muscular co-contraction around the joints, hence, increased muscle activity. This not only leads to enhanced joint stiffness, but it also limits the force output at the joint, as opposing muscles tend to cancel out each other's force production. This phenomenon, while being useful for remaining motionless, is fundamentally and functionally incompatible with skillful motion, which requires smooth, fluid, and forceful movement around the joints.

When one is required to both stabilize and move on an unstable surface, one is given a task, the elements of which, are essentially incongruous. In other words, it's difficult to move and stabilize at the same time. It can be done, but the outcome is disjointed and choppy motion, with negligible results.

If a lack of transfer were the only issue, then anyone could simply jump on a ball, because it's entertaining, and dismiss the absence of tangible results. But the problems don't stop there.

Drinkwater, Pritchett, and Behm (2007) evaluated the biomechanics of lifting during squats on progressively unstable surfaces, from the floor, to foam pads, and ultimately, to the Bosu™. The authors reported that when transitioning from a stable to a very unstable surface, there were "clinically meaningful differences in kinetics," suggesting that form and technique are severely compromised by the instability. Further egregious, are the findings of Verhagen, et al (2004), who noted that training on unstable surfaces increased the risk of knee injuries in subjects with prior histories of knee maladies. This finding raises quite a controversy, as unstable platforms are frequently employed in the rehabilitation of knee injuries. Are they really just impeding progress instead?

These studies do not even allude to the potential hazards associated with hopping, jumping, and leaping onto unstable surfaces, so in the end, these devices may not only have little positive effect on functional outcomes, but may actually disrupt movement mechanics and place people at an increased risk of injury.

The truth is, that under highly controlled conditions, unstable surfaces have their place in the treatment of ankle and lumbar spine dysfunction. They are even useful in many forms of core strengthening, given proper posture and technique. In this respect, unstable exercises deserve a rightful place in health and fitness centers.

But it is not uncommon for highly specialized clinical applications to become trendy practices in the fitness domain, where despite the lack of scientific support, they are continuously used in a mainstay fashion. In this case, the risks certainly outweigh the rewards. Perhaps it's time to step back and take stock of our fitness practices, by developing a better understanding of the basic scientific principles which underlie those applications, and in that way, become more grounded. Literally.

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WORLD HEADQUARTERS

10 Trotter Drive • Medway • MA 02053 USA • T +1.508.533.4300 • F +1.508.533.5500

CYBEX INTERNATIONAL UK LTD

Oak Tree House • Atherstone Road • Measham • Derbyshire • DE12 7EL UK
T +44.845.606.0228 • F +44.845.606.0227


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