

# The effects of instability on countermovement jump performance



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Post-activation potentiation (PAP) is a phenomenon whereby the performance of explosive movements (e. g. sprints, jumps) can be enhanced by executing a heavy resistance exercise (activation exercise) immediately prior to the explosive movement (Robbins, 2005). Two possible physiological mechanisms have been suggested to explain PAP: a) an increased phosphorylation of the myosin regulatory light, which allows more calcium ions to bind with actin and myosin enhancing force production at the structural level (Hamada et al.

, 2000); or b) an enhancement of the H-reflex, a heightened neuromuscular response elicited by the Group Ia afferent muscle nerves which increases efficiency and rate of the nerve impulses to the muscle (Hodgson et al., 2005). PAP has been found to increase the rate of force development (RFD), a vital component to activities requiring dynamic muscular contractions (Sale, 2002; Baudry & Duchateau, 2007), thus maximising explosive power for athletic performance (Horarh & Kravitz, 2008). A large number of studies have shown acute performance improvements as a result of a PAP protocol (e.

g. Sale, 2002; Robbins, 2005). However most studies employ a heavy resistance activation exercise (e. g. back squats, hang cleans) which are not applicable within a real-world competitive setting (e. g. prior to an athletic competition), nor do they mimic the forces, velocities and joint stability required during explosive/jumping actions.

Recently, a collection of scientists have started using drop jumps (DJ), a popular plyometric exercise, as a PAP activation exercise to elicit performance improvements in explosive movements. Drop jumps can be easily performed and could be incorporated by athletes, without practical difficulties, into their warm-up routine prior to competitions. The results so far are encouraging since the two most comprehensive studies which employed drop jumps as a component of warm-up strategies have shown positive changes in the performance of subsequent competitive explosive movements (Hilfiker et al., 2007, Terzis et al., 2009). There are two widely accepted variations of drop jumps: a) Modified drop-jump: from an upright position on a wooden box the performer steps off and lands on the floor by stabilising the knees in 90° flexion. b) Bounce drop-jump: from an upright position on a wooden box the performer steps off and lands on the toes, to minimise the ground contact time, followed immediately by a vertical jump.

Drop jumps instigate high eccentric muscle actions during the landing phase and they are always performed on a solid floor. Drop jumping could, however, be advanced further if performed on an unstable surface in an attempt to elicit greater PAP effects since the added stimulus of balance maintenance may lead to an optimum neuromuscular excitation. The performance of exercises on unstable surfaces instigates increased agonist-antagonist co-activation in order to maintain stability about the joint and reduce potential injury, thereby reducing power output of the agonist muscles through reciprocal inhibition (Anderson & Behm, 2005; McBride et al.

, 2006; Behm et al., 2009). Furthermore, performing exercises on unstable surfaces increases the activity of the spinal column muscles; a reaction that can have a positive effect on the function of the leg muscles since they will share the task of postural stabilisation with the spine muscles (Anderson & Behm, 2005).

In terms of drop jumps performed on unstable surfaces, this could mean: a) an increased co-activation of agonist-antagonist lower extremity muscles (e. g. quadriceps-hamstrings) during the amortization (landing) phase of the jump which will result in a high state of readiness to respond to perturbations (Myer et al.

, 2004); b) an increased activation of abdominal and lumbar spine muscles which may allow a better conditioning of the leg muscles. Therefore the use of unstable surface drop jumping as a preparatory exercise in warm-up routines prior to competitive explosive movements, which rely on the explosiveness of lower body muscle groups (jumps, sprints, shot throws), may create optimal neuromuscular conditions and enhance the explosive capability of the muscles for the performance of the subsequent competitive movement. Among the unstable training devices available, the BOSU is ubiquitous to health clubs and elite sport alike, yet despite the high commercial presence has received little attention within the scientific literature. The primary application of this air-filled domed device has focused on static balance based lower-extremity exercises during rehabilitation programs but not as a vehicle to enhance the difficulty of explosive plyometrics such as jumping. The dimensions and the degree of instability

that BOSU offers constitute this device as an ideal tool to create an unstable surface for jumping.