The Use of Post Activation Potentiation (PAP) to Improve Athletic Strength

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Summary of Presentation

A well-designed pre-activity warm-up will bring about various physiological changes that will enhance the training activity or competition. Time restraints for training sessions are often a reality for coaches necessitating alternative pre-activity preparation methods. Recent research indicates that alternative warm-up methods have the ability to bolster an athlete’s strength/power potential. Post Activation Potentiation (PAP) is the contractile history of a muscle which influences the mechanical performance of subsequent muscle contractions. Fatiguing muscle contractions impair muscle performance; whereas, non-fatiguing muscle contractions, typically at high loads of brief duration, may enhance muscle performance (Stone, Sands, Pierce, Ramsey, & Haff, 2008). Thus, PAP is the increase in muscle force and rate of force development that occurs as a result of previous activation of the muscle. The proposed mechanism for PAP is the phosphorylation of myosin regulatory light chains, which renders actin-myosin more sensitive to Ca2+ released from the sarcoplasmic reticulum during subsequent muscle contractions (Grange, Cory, Vandenboom, & Houston, 1995; Sweeney, Bowman, & Stull, 1993; Vandenboom, Grange, & Houston, 1995). The purpose of this abstract is to discuss this valuable pre-activity preparation technique.

Although PAP is a well-known property of muscle, the impact of PAP on human performance is not well understood (Bishop, 2003; Robbins, 2005; Sale, 2002). The research is ambivalent to-date as to whether PAP enhances human performance (Bishop, 2003; Robbins, 2005; Sale, 2002). Theoretically, PAP would increase the rate of force development (RFD) that would lead to an increase in acceleration and velocity (Sale, 2002). The PAP effect would shift the traditional force-velocity curve upwards and to the right which may potentially enhance strength and speed performance (Sale, 2002). Brief high-intensity contractions preceding a brief maximal effort during an athletic event that involves jumping, kicking or throwing may increase the RFD (Robbins, 2005). Increasing RFD would in turn increase the strength and speed attained during the performance of an athletic event that involves a brief maximal effort. For example, the throwing of any field implement could be improved using the PAP techniques (Robbins, 2005).
The benefit of utilizing PAP in training is clear in theory, but research utilizing PAP has not been able to clarify its practical application. One report indicates improvement in jump squat performance five to 18.5 minutes following a heavy-load PAP warm-up in power-trained athletes without a concomitant effect in recreationally trained individuals (Chiu, Fry, Weiss, Schilling, Brown, & Smith, 2003). If PAP is to be used for enhancing athletic performance, the specifics of the conditioning or warm-up protocol need to be addressed (Robbins, 2005). The training variables requiring consideration include type of contraction (e.g., isometric, concentric-eccentric, etc.), intensity, volume (e.g., repetitions, sets, cadence, etc.), rest interval(s) between possible multiple sets, rest interval within the complex pair, and possible varying responses of different muscle groups (Stone et al., 2008). Research also highlights the effect of PAP and categorical variables (Stone et al., 2008). These include training status, training age, chronological age, genetics (e.g., fiber-type composition), anthropometrics, gender, relative strength, and absolute strength.
Resources


Author Bios

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